THE

ELECTRICAL REVIEW.

VOL. XLV. NOVEMBER 3, 1899. No. 1,145.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1899

Edition

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ELECTRICAL MANUFACTURERS AND THE LABOUR PROBLEM.

ONE of the chief problems our English manufacturers of electrical machinery have to face, and which appears to present increasing difficulties, is the supply of workmen. To those behind the scenes, it was somewhat startling to hear that the British Westinghouse Company proposes to put down works and employ 5,000 men in the manufacture of electrical appliances. It is a comparatively easy matter to build the works, and to purchase the tools to fill them, but the building up of an army of workmen is quite another matter. If we go over the works of any of the leading manufacturers in this country, we find employed in them a large number of mechanics, turners, fitters, and machine men of much the same class as are found in ordinary shops where engines or machine tools are manufactured; but in addition to these, we have workmen employed on the duties peculiar to electrical engineering, such as the various winding and insulating operations, the erecting, coupling up, and finishing of dynamos, transformers, lamps, and similar matters, where all must have some knowledge of the peculiar requirements of electrical apparatus, such as the necessity for the careful sub-dividing of the iron cores to prevent waste currents, the careful insulation of the turns of winding from one another, and so on.

As regards the supply of workmen for the first or mechanics class, electrical manufacturers have to take their supply from the great body of fitters, turners, and engine erectors who are to be found all over the country. At the present time there is no supply of trained workmen of this class. It is not an exaggeration to say that every man who is a fair workman, and a good many who are indifferent ones, are in full work, the only men out of work are either bad workmen, or notoriously bad time keepers.

Of late years, in all well-equipped shops, there has been an increased use of automatic machinery; that is to say, of various forms of lathes and small tools which are worked on the "Stop" system, the tools and stops of which can be adjusted by a foreman, and the manipulation of which is left to boys or the younger class of labourers. This has somewhat reduced the difficulties due to the paucity of turners, but even with automatics it takes some considerable time to train a lad to work them to their full rate of output. It is abundantly evident, therefore, that as regards this class of workmen, those who talk so glibly of establishing works on a large scale, will find that they are brought to a dead stop so soon as they attempt to get the men together to work their tools and do the mechanical portion of the erection. There is undoubtedly a paucity even of this class of workmen, so that new works can only be filled up by importing men from abroad, or by bribing them to leave other shops. There is not much probability of the latter course being adopted. For the last two years, in fact, ever since the great strike, very considerable solidarity has existed between employers in engineering shops, and any attempt on the part of a new firm to bribe workmen to leave good places would be so bitterly resented by the general body of existing employers, and probably by the workmen themselves, that it

is not likely to be carried out to any considerable extent. As regards the other class, *i.e.*, the winders, who do not require such a careful mechanical training, but who must be intelligent, careful, cleanly and neat in their habits, and quick to observe the causes of short circuits or other troubles which follow on careless workmanship, there is undoubtedly a considerable supply of labour from which electrical workmen may be recruited. There are plenty of sharp lads born in London whose prospects of living a useful and comfortable life are much improved by taking up this branch of work. The Londoner is a sharp and intelligent observer, and he does not take long to train for this work. The chief difficulty in dealing with a Londoner is that, if you remove him into the country he feels, especially when young, the dullness of living in a country town as compared with the opportunities which exist in the metropolis for amusement on the Saturday evenings and Sunday.

This brings us up to the second question connected with this highly important matter of the supply of workmen. Employers will be well advised if they realise after all that their workmen are human beings, who require some change from the monotony of their daily toil; those who have already realised this, and who have provided reasonable means of recreation for their men have, we think, already reaped their reward in finding it much easier to obtain a supply of men than those who have done nothing of the kind. A country town possesses considerable advantages for the establishment of electrical works. As a rule, there is not nearly so much fog or darkness as in the great centres such as London, Manchester, Sheffield, or Glasgow. The work can therefore be carried on under better conditions. The air is not nearly so damp, satisfactory insulation tests can be obtained without the necessity of the work having to be previously placed for many hours in the drying oven. No doubt due to these advantages, there is a tendency on the part of electrical manufacturers to move out of large towns, and we think we shall be doing good service to those who have already moved out, and to those who intend to do so, when we point out how important it is that they should, when they establish their new works, thoroughly consider the question, not only of the comfort of their workmen, but of the providing of reasonable means of passing their time, not only in the long winter nights, but also in the summer evenings, where outdoor recreation is possible. The winter evenings can be dealt with by well-arranged classes, by clubs and lending libraries. We may even go so far as to suggest that where the magnitude of the works permits of it, the employers should assist in the establishment of a concert or music hall.

As regards the summer, every help should be given to the men for the establishment of cricket and sports' clubs. The possession of grounds comprising a well laid out cricket field, cycle track, and gymnastic appliances, is a good method of keeping the men in good health, and consequently in the best condition to do their work in the manner most satisfactory to their employers.

Nomenclature of the C. G. S. Units.

We have recently noticed several proposals for changes in the names and dimensions of the practical electrical units, made in both American and French papers; and an article in *l'Industrie Electrique*, of September 10th, carries the discussion a stage further. Of the articles to which we have already called attention, the two principal ones have appeared in the *Electrical World* of New York, and in *l'Industrie Electrique* respectively. The article in the latter journal, to which we are now referring, is signed by M. E. Hospitalier, and contains a long letter from M. Blondel, who informs us incidentally that the article in the *Electrical World* was from the pen of Mr. Kennelly. It appears that these three writers, and, we presume, the editorial authorities of their journals, are agreed upon the desirability of the following three steps:—

1. The adoption of names for the C. G. S. electrical units.
2. The abandonment (by degrees, and in some way calculated to cause as little inconvenience as possible) of the present "practical" system, based on a set of derived units whose values are 10^9 C, 10^{-11} G, S, respectively.
3. The creation of prefixes for a limited number of powers of 10 (multiple of 3 exclusively, and particularly the multiple 10^9).

There is at present no sort of agreement as to what these names are to be, but there is some indication that a serious attempt will be made at the Paris Congress of 1900 to get accepted proposals to be made on this point. There can be no doubt that if all names and all derived units had to be devised for the first time, M. Blondel's terms would be preferable to those which are in use; and that names for the C. G. S. units would be exceedingly convenient. The inconvenience of a change is, however, very serious.

Physical Society Meeting.

It frequently happens that a significant and suggestive experiment, described perhaps in some little-known foreign journal, is lost sight of by the generality of physicists in this country, simply because the original observer is himself too remote to bring it forward. To overcome this difficulty, Fellows of the Physical Society who happen to have the necessary resources are now invited to prepare the experiment and to exhibit it at one of the ordinary meetings at Burlington House. The idea is not altogether a new one, for the Physical Society have always shown their appreciation of exhibits and demonstrations of this kind. The present invitation is given with a view to extend the custom, and, if possible, to make such exhibitions one of the features and pleasures of each meeting. The first piece of apparatus that excited attention last Friday was a lantern with a hissing arc and hygroscopic slides, designed to illustrate absorption and the colours of thin films. By means of a universal carrier the slides were set at different angles; and an ingenious mechanical device, acting for short periods, properly timed, enabled the hygroscopic condition to be intermittently dispelled. Under these conditions, the thickness of film is proportional to the cosine of the angular displacement, and the visibility is a function of the optical intermittence. This lantern was also used for projection purposes, but not with equal success. A paper by Dr. S. W. Richardson on "The Magnetic Properties of the Alloys of Iron and Aluminium," was only read in abstract; this is by far the best method of presenting such papers. The author has obtained **B—H** curves for various alloys through long ranges of temperature, from the solidification point of CO_2 to red heat. Mr. G. L. Addenbrooke's model, described as "Illustrating a number of the actions in the flow of an electric current," led to a discussion on the old problem of the value of mechanical analogies in demonstrating electrical quantities. Since it still leaves us with such phrases as "the flow of an electric current," we are rather inclined to think there is, even now, something adrift. Of course, the model is intended to indicate that there is no "flow" in the wire, *i.e.*, no current, in the fluid sense. And we should have thought that, *a fortiori*, there was no "flow" of the "flow." The repetition by Mr. W. Watson of some experiments by Prof. Lecher was a pleasant climax to a very successful meeting. Nobody, however, seems to have pointed out that the climbing of the discharge up the splayed wires is a comparatively old phenomenon. We have an idea that Ferranti invented a lightning-guard on this principle. Certainly Elihu Thomson did (American Patent No. 434,961, August 26th, 1890), for he explains that "the arc so established will rise to the upper and wider portion on account of the current of air established by the heated flame, and will be bowed and eventually broken at the upper portion of the space." A few years later Siemens & Halske (D. R. P. No. 91,138) made some improvements along the same lines; and in *Dingler's Polytechnisches Journal*, page 215, 1897, will be found a very beautiful photograph of the discharges ascending the deviating conductors.

ELECTRO-PNEUMATIC SIGNALLING.

(*Concluded from page* 682.)

To each of these parts wires, connected to a solenoid, the core of which forms, or is connected to, the valves con-

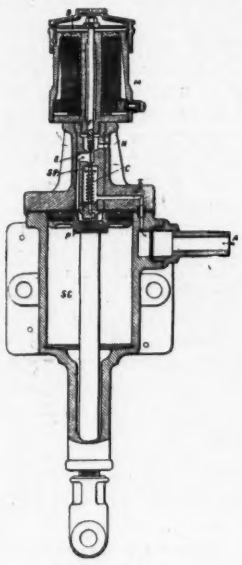


Fig. 5.

trolling the inlet and outlet of the air in the cylinder, are attached. These wires serve to convey electrical energy imparted to them in the signal box. The action in relation to the signal movement will be made clear on reference to fig. 5.

Air, under pressure, enters from the main pipe, through the connection, A, and passes through the passage, T, to the interior chamber, C. This chamber contains a valve, S P, held closed by a spiral spring, and the spindle of this valve is prolonged upwards and inserted in the spindle, F, of the armature, B, of the solenoid. F has a conical seating, so that it may act as the exhaust valve. On the solenoid, M, becoming energised, the armature, B, is attracted; the spindle, F, then closes the exhaust passage, and, overcoming the influence of the spiral spring, C, pushes the spindle, S P, off its seat, thereby admitting compressed air through the passage E to the space above the piston P. The pressure

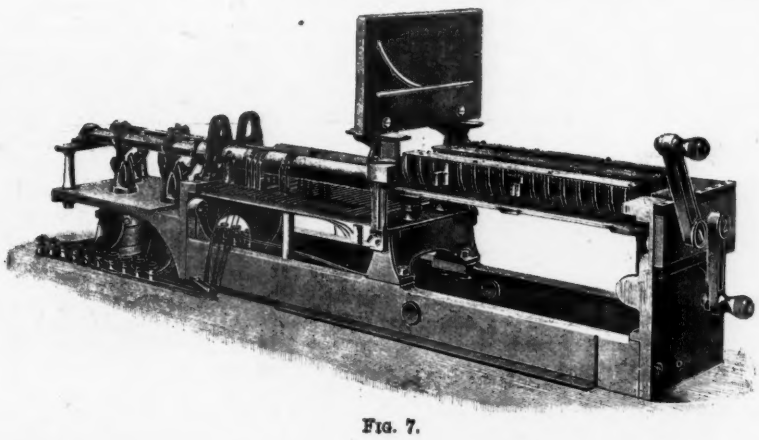


Fig. 7.

exercised by the air thus admitted above P propels the piston forward, and as the rod connected with it is also connected with the lever operating the signal arm, the action results in placing the arm in the "all-clear" position, in which

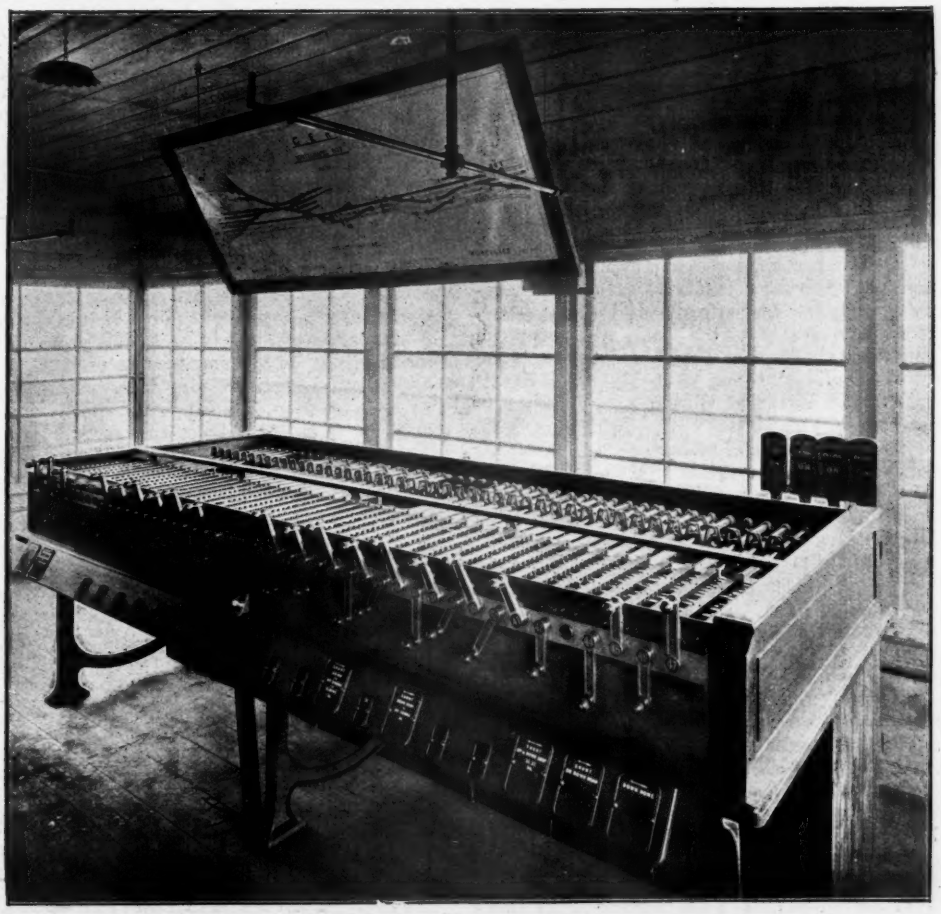


Fig. 6.—Interior of Signal Cabin with Electro-Pneumatic Locking Frame.

it remains so long as the pressure of the air is sufficient to counteract the counterbalance weight of the signal.

On the electric circuit being interrupted, the armature B, under the influence of the spiral spring C, is raised, and the admission of air from the main inlet, A, is cut off. By the same action which secures this, the exhaust passage at E is opened, thus allowing the pressure of the air in the cylinder S C above the piston P to be reduced to the normal, or that at the port H.

The point motor is operated in a somewhat similar manner, with this difference, that the air piston, which moves the points in the same manner as, in the signal motor, P moves the signal, is not returned under the influence of a counterweight, but by air pressure on the opposite side of it. It consists, in fact, of two signal motors, but instead of these operating the points direct, they operate a slide valve, thus admitting compressed air to one side or the other of the piston head. The electric circuits are so arranged, that when one magnet is energised, the other is free. The first portion of the piston travel unbolts the points; with the continuation of the movement, the points are thrown over and locked in that position, and at the final portion of the movement a circuit in the indicator box fixed in the signal box is completed. The completion of this circuit releases an electrical lock on the lever, and thus allows the operator to complete its movement.

We have now to look at the means by which these parts are operated. The action is not effected, as will be readily conceived, by the movement of the ordinary point and signal levers. One of the purposes in view in the establishment of this system is to save labour in manipulation; another is to economise time, and a third is to save space. Fig. 6 shows the point and signal frame, which has been installed at Bishopsgate. It consists of 38 levers, and has space for nine more if required. It is 10 feet 8 inches long, and, of the 38 levers, 12 work 25 semaphores and ground discs, and 26 work 43 points, one facing point lock and bar, and two lock bars. With the ordinary form of signal lever no less than 53 would be required, occupying, it is unnecessary to say, a much larger space. The lever employed is really an electric switch or commutator, having certain electrical and mechanical connections, by means of which the various circuits may be operated and interlocked. Thus, if a particular point lever is moved, the current, on throwing over the signal lever, pervades one group, and thus operates one set of signals, whilst another point lever would in like manner admit of the operation of another group of signals, embracing, possibly, one or more of those operated by the lever previously referred to, but applicable to a different arrangement of route. It will be clear that with such an arrangement various combinations are perfectly feasible and easy.

Fig. 7 represents a section of the frame with two levers only, and which may be seen at the Westinghouse Brake Company's works at King's Cross, or at Messrs. McKenzie and Holland's Signal Works at Gloucester. The lever to the left is a point lever, and that to the right is a signal lever. With the points in one direction one set of signals can be moved, whilst if the points are in the opposite direction another set can be operated. If the points are in a position for a train to move in one direction only, the mechanical interlocking of the two levers is such that the signal lever can only be moved in a corresponding direction.

Each lever is some 5 inches long. It is keyed to a horizontal shaft, of which the portion nearest the lever is employed to work the mechanical locks, which are in all essentials identical with the system of locking generally in use; but, in addition, the Westinghouse system affords a second and electrical means of locking the levers. Each of the horizontal shafts carries an extension, to which are keyed certain locking bars or sectors, which are arranged to work in harmony with the electro-magnets seen immediately below this portion. These magnets are in circuit with wires which come back from the point or signal controlled by that particular lever, and it is only when this current has reached the frame that the action desired by the operator can be completed. Thus, when a signal has been taken off, and again placed at danger, no change can be made in the frame which could conflict with that previously made until the signal has assumed the danger position, and sent a current through the signalling lever magnet, and so released the lock on the sector. Point levers require to be operated under two motions—the pull stroke cannot be made in one. The first portion of the movement interlocks the lever with one of the sectors, and until this is released by the return current, which, as previously explained, is only sent from the "point" itself on the completion of its turnover and the operation of the bolt, the full stroke cannot be completed.

The operation of the frame is thus as follows:—Having ascertained the route of the train, the signalman places all the switches, or combinations of switches, involved, in the necessary positions, by the movement of the various switch levers. This he is unable to do unless all the signal levers which interlock the switches involved in the combination are at the normal position. He then moves the signal lever controlling the signal arm governing the train, thereby locking the switches and admitting air to the signal cylinder. If any circuit is damaged, or a battery out of order, or if the air pressure is insufficient, the signals affected go to danger and remain so until the defect is remedied.

It will be clear from the short description which we have been able to afford of the operation of this system that it possesses certain advantages over the system generally in use in this country. In addition to those previously referred to, we have the abolition of signal wires and point rodding. The wear and tear of the signal is not so great, its action being more graduated and accompanied by less jarring. The position of the signal arm is always the same when pulled off, and is not subject to variation consequent upon the contraction of the wire by fluctuation of the temperature. Where convenient, a large range of roads and signals may be operated by one man from one central point. The system in itself is a valuable one, well thought out, and possessing many advantages. It is, of course, applicable to sections of line as well as to station yards. A central generating station can supply the requisite pressure of air to serve other groups of signals or points than those within its immediate neighbourhood. The drawback, if any, resides in the fact that the requisite pressure of air must be maintained, as must also the electrical pressure. There must be no leakage in either respect. The seating of the valves and the working ability of all parts must be accurate. The absence of this does not entail danger, for in case of failure the signals, as stated, fall to the danger position. But on a busy line stoppage of traffic is impossible. We do not assume that such gear as that we are discussing is more liable to derangement than the apparatus now in use, but when failure does arise, apparently it requires the immediate presence of a mechanic to adjust it. With the signalling gear generally employed on British railways, defects can usually be temporarily adjusted by those who are on the spot. Saving in labour is undoubtedly to be desired. The operation of many of our signal boxes as at present equipped must entail severe physical strain, and if this can be avoided, it ought to be. Whether there would, in the employment of such a system, be a saving in the number of men employed at present, is probably an open question. Wherever the signal box is, there a man must be in order to direct the traffic. It would be easier for him to operate the signals and points by the electro-pneumatic than by the present means, but in point of *cost* there would appear to be little, if any, difference, except in the case of large stations. The system not only insures a satisfactory operation of the signals and points, but by the aid of the return signal on the completion of the movement of the point or signal, prevents the signalman from making a conflicting movement. It may, of course, be argued that this is practically assured under the existing mode of working. Granting this, there are still features attending the electro-pneumatic system which make the experimental test at Bishopsgate worth studying, and it is one which we shall watch with interest.

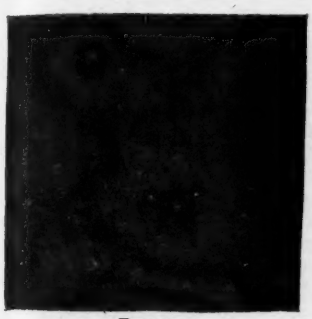
AN ELECTROLYTIC METHOD OF SHARPENING FILES.

By SHERARD COWPER-COLES.

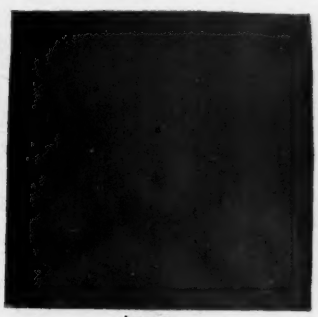
Those who are accustomed to use files know only too well how quickly they lose their cutting edge, or become clogged when employed for certain classes of metals and alloys.

A file card will clean a file in many cases with difficulty, but will not sharpen the cutting edges. The only process that has been successfully applied to the sharpening of files up to the present, is Tilghman's steam sand blast; fine sand is projected on the file with a steam pressure of 150 lbs. through rubber hose fitted with cast-steel nozzles. The harder the surface to be operated on, the greater is the resistance offered, and the more vigorous is the action of the sand.

It occurred to the author that cutting edges might be readily sharpened by dissolving off electrically a thin and even film of the steel. A large number of experiments were made for the purpose of determining the best conditions. The effects of various current densities and electrolytes upon the cutting edges of the files were recorded by means of impressions taken on lead foil, and also by taking micro-photographs, some of which are now reproduced. Another method for recording the results obtained was to take gutta-percha moulds from which electrotypes were produced. Current densities were tried varying from 1 to 500 amperes per square foot, and with variations of time from five minutes to 60 hours. A large number of electrolytes were also experimented with, including cyanide of potassium, ferric chloride, ferric sulphate, and solutions of sulphuric acid of different strengths; the best results were obtained with a solution of ferric chloride with high current densities.



Before.



After.

The following two micro-photographs show a cross-cut file before and after treatment in a solution of ferric chloride; a current density of about 500 amperes per square foot was used for 15 minutes.

[An electrolytic process of re-sharpening files is described in Kempe's "Engineers' Year Book;" page 313 (1899 edition).—Eds. Elec. Rev.]

ELECTRICAL DISTRIBUTION OF MOTIVE POWER.

This subject, which quite recently was briefly treated by us in these columns, has been brought before the Manchester Association of Engineers by Mr. J. S. Raworth, who at once admits the difficulties in the way of obtaining exact data. This scarcity of data is obvious in the Appendix to the paper, in which numerous tables are given of great value, so far as they go, but it is a characteristic commentary on these, that the motors tabulated, and the data given for them, are all of foreign origin. Are British motor makers unprepared to publish the efficiency of their productions?

The author refers principally to supply for motive power from local supply service, and from a general power distribution service. The latter source of supply might have been more fully treated, particularly in view of the possible sanctioning by Parliament of the various large schemes which were unsuccessful last session, for there ought to be a large quantity of available data regarding these schemes.

The subject of the paper is a mixture of several distinct inquiries, all bearing upon each other, but still capable of separate treatment. The cost of electrical energy delivered, the cost of motors and their efficiency, the sub-division of the power, the efficiency of mechanical distribution; all these enter into the question, together with other points apt to be overlooked, such as valuable space occupied by boilers, engines, chimneys, coals, ashes, and all the pipes, pumps, and so on, connected with a steam plant. With all these matters to take into account, when an engineer is called upon to advise upon the adoption of electrical distribution of power, it is no easy matter to present the whole case, for or against, in a convincing and conclusive manner.

We think the best way to put the matter for a general power distribution scheme, is to assume a case. Take a town, for instance, in which there are, say, 50 power users of steam plants, with a total indicated power of, say, 2,500 H.P. In the generation of this power we shall find at least 50 men employed as attendants, and 50 engines, with, say, 60 boilers, and all their appendages. All these separate plants will require, in the aggregate, some acres of space, and run into a large amount for maintenance.

Now, if into this town we introduce a general power supply by electricity, we could run a central power plant of the highest efficiency to supply the whole place with, say, three engines and dynamos, four boilers, and not more than a dozen men. We cannot here go into the figures of such an instance, but those who care to do so, will find that there cannot be a clearer case made out to show that electrical distribution enables power to be delivered within a certain area at a cheaper rate than it can be generated by steam plants scattered over the district.

This example illustrates fairly what is meant by a general power distribution service. It could not offer much inducement to the large power user, who can employ large economical engines, but to the thousands of small users it would offer many advantages and at the minimum cost.

This system might be called the primary distribution. Laying on the power from a centre to many consumers, it is not a question complicated by the efficiencies of motor shafting, and so forth. It is when we come to consider the question of distributing the power inside the works, or what might be called secondary distribution, that complications arise.

The two distributions must be considered apart; the first concerns the generators of the power, the second the users of the power.

There can be no doubt that the time is ripe for the establishment of primary distribution systems, and there need not be much difficulty in the substitution of the electric motor for the engine and boiler. As to the secondary distribution, that is settling down by itself in every day experience.

The main question is one of sub-division. Extreme sub-division means small motors and no shafting, large motors introduce shafting, that is the difficulty. Small motors are less efficient than large ones, hence we have to decide between small inefficient motors with no shafting, and large efficient motors with shafting, which probably wastes much more than is gained in the motor, and Mr. Raworth's reference to the steam engine of high efficiency wasting its power on shafting and belts, applies equally to the large efficient motor driving shafting.

This is proved conclusively by the results of a test recorded in the paper which we quote:—

> The engine, which is a "D Universal," is capable of indicating 45 H.P. It drives 288 feet of 2½-inch shafting, and 46 belts.
>
> The indicated horse-power required to drive the shafting and idle belts is 9·1, equal to 6,788 watts.
>
> The average load (indicated) is 17 H.P., and the maximum load 30 H.P., consequently the average efficiency is only 47 per cent.
>
> Another line of shafting of the same size (2½ inches), and 144 feet long, driven by a motor, takes 2,570 watts; but in this case there were only 16 idle belts. Consequently, to make the comparison fair, we must add seven belts at 67 watts each = 469, making a total of 3,039 watts. If this be doubled, to make the comparison fair with the steam engine driving double the length of shaft, we obtain a total loss of 6,078, as compared with 6,788.
>
> This result is much more favourable to the steam engine than is commonly supposed.

We do not know upon what grounds any other result could be expected.

Sub-division, we believe, will be carried out in most cases, down to 1 or 2 H.P., with possibly certain limitations, as, for example, in the driving of lathes.

For primary distribution it is debatable whether polyphase or continuous current is better. Much can be said on both

sides, but we are inclined to think the continuous current has the best of the arguments. Much depends on the magnitude of the scheme.

As Mr. Raworth has collected a number of tables of value, we shall refer to these in another article. The paper is admittedly incomplete, but it will have served a good purpose if it raises an interest in this promising line of electrical engineering activity.

The municipal supplies now at work are governed by conditions totally different from those which would apply to a pure power supply, so that it is of no value in the discussion to refer to results of the working of those plants mostly supplying light.

The author's enthusiasm carries him so far as to attempt running cotton and other large mills by motors, but we doubt if the large well-managed engines can be beaten. There might be a saving in distributing the power electrically inside the mill, but to go so far as proposing to compete in these cases seems to us like attempting to drive in the thick end of the wedge first.

THE SULLIVAN SIGNALLING GALVANOMETER.

As the result of Admiral Dewey's cable experiences last year (after the destruction of the Spanish fleet in Manila Harbour), when he failed to communicate through a cable which he had grappled and raised, Mr. Sullivan set to work to design an instrument and a system which would enable a naval commander in war time to readily establish communication through any submarine cable, whenever the exigencies of the case might require it.

As is well known, the Sullivan galvanometer as at present used in the Navy, and by the cable companies generally, is very suitable for mirror speaking purposes when used in

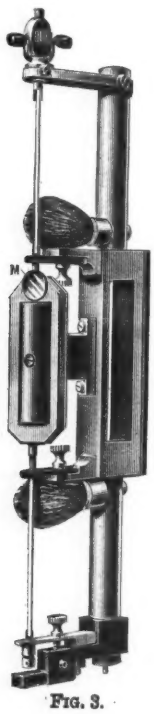


Fig. 3.

conjunction with the ordinary auxiliary apparatus hitherto found necessary, viz., condensers, switches, or short-circuit pieces, and in some cases sending shunts. It has, indeed, been successfully applied on board ship as a syphon recorder, which is the first instance on record of such an instrument being used on the high seas.

Recognising, however, that the ordinary signalling arrangements would hardly suit the requirements of the Naval Service, Mr. Sullivan set to work to so modify his galvanometer as to enable the before-mentioned auxiliary instruments to be dispensed with, and a thoroughly practical and reliable apparatus to be available, which would be equally suitable for receiving messages on *any* length of cable.

Owing to the fundamental difficulties of the case this was not found to be an easy problem. Briefly stated, on short well-insulated and comparatively non-inductive cables, practically the full impulses transmitted reach the distant end *at once*, and the received signals may be represented diagrammatically thus (fig. 1). But on long cables, owing to the retardation due to the electrostatic capacity and absorptive power of the insulating material surrounding

Fig. 1.

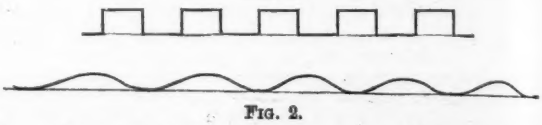


Fig. 2.

the conductor (which retardation increases as the square of the length), the signals tail and lose their individuality, reaching the distant end of the cable more or less weak, sluggish and wave-like in character, as shown by fig. 2. To this retarding effect is super-added the inertia of the suspended coil, and hence it has been necessary hitherto to employ signalling condensers (or some other curbing device) to compensate retardation as much as possible, so as to render the received signals more defined and legible.

It will be noted that the two damping devices which Mr. Sullivan employs, have a very different function and action. The damping of the frame on which the coil is wound is due to the powerful opposing currents set up in the coil system, as it swings in the field of the permanent magnet. The camel's hair brush, on the other hand, gives mechanical or frictional damping, the effect of which is to retard movements of the coil, until the received impulse, or signal, or wave, has attained a potential sufficient to give the coil a more or less rapid swing; thus the effect resembles a smart blow, and not a blow followed by a push, as would be the case without the camel hair brush. In his galvanometer Mr. Sullivan has utilised these two effects and made them in great measure counteract each other; that is to say, the electro-magnetic sluggishness of the coil is atoned for by the mechanical or frictional damping.

By no adjustment of the brush, however, could the sluggishness be so overcome as to get sufficiently sharp and well defined mirror signals on very long cables under the conditions aimed at, but finally success was obtained in the following manner, viz.:—

1. By reducing the electro-magnetic damping of the coil system.
2. By increasing its mechanical damping. (This is done by employing two camel hair brushes.)
3. By increasing its control.

The *flat spring* suspension, by which the desired result was obtained by Mr. Sullivan, is very effective. A round wire suspension has, we believe, been suggested for such a purpose, but, so far as we are aware, a flat spring with its better control has never before been suggested or used for "speaking."

As compared with the ordinary signalling galvanometer, the advantages of the "Sullivan" type are:—

1. It is exceedingly simple, no auxiliary instruments beyond a battery key and a few cells being required for receiving messages through cables of any length.
2. One and the same galvanometer serves for all lengths, as, by means of the camel hair damping, the signals can be made dead-beat on even a mile of cable.
3. It requires no "sending" switch, the inadvertent neglect to turn which from "sending" to "receiving" frequently causes trouble in practical working.
4. The sender can read his outgoing signals, and see that all is right, as owing to the robustness of the suspension the signals can be sent direct through the galvanometer without injuring it.
5. The distant end can interrupt the transmission at any moment if necessary.
6. It is unaffected by moving masses of iron or the numerous vibratory and other disturbances experienced on board ship.
7. The suspension, instead of being a weak point, as in ordinary speaking galvanometers, is as strong, practically,

as the instrument itself, so that it is never likely to fail at critical moments. The simplicity and thorough practicalness of the instrument are points of paramount importance and cannot be over-estimated.

"*Instruction*" *Galvanometer*.—The object of this instrument is to reproduce, for instructional purposes, signals of the same character as those actually obtained on cables of various lengths, or, in other words, to imitate the retardation of long cables. The fundamental reasons, owing to which signals must necessarily vary in character according to the length of the cable we have already dealt with, and the difficulties encountered in meeting these conditions have also been referred to.

At first it was thought that if long cable signals were to be exactly reproduced or imitated, some sort of inductive resistance, short of an artificial line proper, would be indispensable; such, indeed, has been the common belief, and accordingly, Mr. Sullivan started experimenting in this direction. Eventually, however, and after much experimentation, he found that the end in view could be attained otherwise, viz., by merely increasing the electro-magnetic damping of the coil frame. Inductive resistances are entirely dispensed with and (what is a most noticeable point), *not even a shunt on the galvanometer is used*.

In this case only one camel hair brush is used, and a finer suspension than that employed for the ocean signalling instrument, while the coil frame is not cut through; but in every other respect the two suspension frames are alike and are interchangeable. With the brush removed, the signals resemble those from a long Atlantic cable, and by simply varying the position of the adjustable camel hair brush, the pressure of which on the suspension regulates the period, signals of any desired character or sharpness can be imitated; this is testified to by a number of cable experts. Another advantage of this "Instructional" instrument is that the learner can send through his galvanometer and watch his own signals, and thus see any fault or mistake in his transmission.

The general form of the suspended coil, with the flat spring suspension, is shown by fig. 3, M being the mirror.

In conclusion, we must heartily congratulate Mr. Sullivan on the success which he has attained, by such simple means, in endeavouring to solve what was really a very difficult problem.

TRANSMISSION OF POWER IN FACTORIES.

[COMMUNICATED.]

The leading article in your number of October 18th is so full of interest to everyone engaged in applying motors for power purposes, that the writer would like to add a few remarks on the subject.

The first point is the advisability of grouping machines together, and driving them by a fairly large motor from a line shaft.

Your leading article points out that this is only successful when the machines are very small, and adds that the motor driving the shaft should not exceed 4 B.H.P. The article continues to say that a few large motors put down to run lines of shafting do not effect economy over the whole system of long lengths of shafting and cross belting to connect one length with another.

The writer thinks that, although this statement is correct to a certain extent, there are a great many cases where it would not apply.

The driving of more modern tools, turret lathes for instance, due to the large number of speeds necessary for them, which can most conveniently be obtained by changing the ratio of the sizes of pulley on the line shaft and countershaft, necessitates a certain length of line shafting to each tool. This being the case, there is no doubt that the best way of driving these tools is to group several of them together on to one shaft, and drive this shaft by means of a motor.

Tools of this description must be continually at work, otherwise they are not paying for themselves, and it is almost impossible to show that, by putting a separate motor to each tool with its accompanying line shafting and countershafting, any economy can be introduced. Then, again, take the class of machine tools usually found in an engineering works, and driven from a length of line shafting—tools such as lathes, planing machines, milling machines, &c., requiring, if driven separately, say, from 2 to 6 H.P. each.

It is almost impossible to show, in cases like these, that a motor to each tool will effect economies which will show reasonable returns on the capital outlay. The only way is to group, say, 6 to 12 machines together (depending, of course, upon the size of the machines) on one shaft, and drive this by means of a motor.

The point should not be overlooked that in driving each tool by a separate motor, a certain margin has to be allowed for in the size of motor for dealing with the maximum load, such as the reversal of planing machine, abnormally heavy cut on lathe, &c., and that the margin in the small motor has to be almost as great as the margin in a larger motor for driving the whole number of machines.

As soon as the size of machine to be driven increases, say, to 10 H.P. and upwards, or where the machines are placed in out-of-the-way places, there is no question that a motor to each tool will amply repay the capital outlay; but to put a motor to each of the smaller tools usually driven from a length of line shafting, would not be advisable.

In designing new shops, great economies can undoubtedly be introduced by making provision for the larger and outlying tools to be driven independently, and by grouping the smaller ones together on lengths of shafting.

In this way the sizes of motors could be kept to units such as 5, 10, and 15 H.P., the 5 and 10-H.P. sizes being chiefly for driving the larger and outlying tools by means of separate motors.

It should be borne in mind that the introduction of electric motors for driving purposes is not going to effect the economies often claimed, unless full advantage is taken of the flexibility of the electrical system in the general arrangement of the shop, and this applies very largely to arranging the tools in such positions that the overhead travelling crane can attend to one machine, and that a workman can bring fresh work to his machine, without in any way disturbing the neighbouring tools.

Another point not often appreciated is the possibility after a shop has been mapped out and is working, of adding additional tools and placing them in advantageous positions by driving them separately by a motor, whereas otherwise it would have necessitated placing the tool under a line of shafting, where it would in all probability either be in the way of the other tools or be in a part of the shop not handy.

Taking the case of a machine shop already erected, one finds belts running from the line shaft to the countershaft, and from the countershaft to the tool, as well as a large number of belts transmitting power from one line shaft to a neighbouring one, and from one floor to another.

It would be impossible, as a rule, to conscientiously advise the introduction of a motor to each tool.

On the other hand, however, great savings can be guaranteed by introducing separate motors to the larger and outlying tools, and by judiciously sub-dividing the lengths of shafting into sections to avoid cross belts, and to enable certain lengths to be worked independently of others either for night shift or overtime.

The second point is the question of spur wheel gearing *versus* belt driving, and the remarks in your leading article are undoubtedly important.

In the writer's opinion, the great secret of success with motor driving lies in having a belt somewhere between the armature spindle and the actual tool, to act, as mentioned in your article, as a flexible link. The writer recently had the opportunity of fully discussing this point with an eminent American engineer, who had devoted a good deal of time to motor driving in the States, where the fashion has hitherto been to adopt spur driving wherever possible, and to embody the motor with the tool. The writer was given to understand that this method of driving was being largely given up in the States in favour of belt driving, excepting in those cases when the nature of the work was extremely smooth and unaccompanied by any jerks.

Readings taken of the power required to drive certain punching machines showed that when the motor was connected with spur gearing the maximum readings were higher than when connected to the same machine by a belt, which

shows undoubtedly that the belt saves the commutator from sudden shocks and jerks.

The third point is the question of using low speed motors instead of the ordinary high speeds. In the writer's opinion, the difference in prime cost between the two is closely represented by the figures given in your leading article, whilst the figures quoted by your correspondent, "Lente," in your edition of October 20th, are too low in the case of the low speed motor, and the difference between the cost of the low speed and high speed installations is not sufficiently marked.

For the sake of argument, however, supposing the additional cost of the low speed installation were only 50 per cent., it is very doubtful whether this extra capital expenditure would be justified, excepting for special cases, where the work was very jerky, or where starting and reversing were constantly necessary. In cases like these lower speeds are often used, but for smooth and continuous running, a large slow running motor seems quite unnecessary.

With the continuous current motors, as made at present by the leading manufacturers in this country, little wear and tear is expected on the commutators with carbon brushes, and as for the lubrication, the present designs of self-oiling bearing would not lead one to expect trouble from them.

From the manufacturer's point of view, low speed motors are undoubtedly desirable, as representing larger machines, and hence increased turn-over to them, but it is difficult to see where the saving is coming in from the user's point of view.

The fourth point refers to the motors themselves. Your leading article states that the enclosed motor is the only one for factory work.

The writer cannot agree with this.

Undoubtedly, in cases where special precautions have to be taken against fire, the enclosed motor is useful, but for shop working, and for use in iron and steel works, shipbuilding yards, &c., where special precautions against fire are not necessary, there is little question that the ordinary open type motor, with every part easily accessible for repairs, inspection and cleaning, is far superior.

Already practical men are beginning to find out that the enclosed motor is not as good for work of this description as the open type, and unless precautions against fire, or damage from materials falling on them, prevents the use of the ordinary open-type machine, it is doubtful whether the enclosed motor will hold its own in works of this description.

The fashion during the past year or so has undoubtedly been towards enclosed motors, and the smaller manufacturers and consulting engineers have considered them the right thing.

The writer's experience, however, differs from the foregoing, and results obtained in several works with open-type motors, extending over a number of years, when compared with the enclosed type, which have been added for extensions, would point to the fact that enclosed motors sacrifice a great many advantages by being shut up, and do not meet with the approval of those who are responsible for their running. In certain cases, however, the enclosed type motor is indispensable.

It should be borne in mind that recently a large number of small manufacturing firms have come into existence, which have laid themselves out for making—if not entirely, at all events largely—enclosed type machines, and the existence of these firms, at all events so far as the electrical department is concerned, depends chiefly upon the enclosed type machine.

Hence one would expect them to advertise and push this design, in preference to the open type two-pole machine.

By watching a few of the leading manufacturers in this country, however—manufacturers who make both open and enclosed type machines—one would come to the conclusion that they certainly prefer the open type to the enclosed, as giving less trouble in working and being easier to look after; and they have drawn this conclusion from practical men, not interested in dynamo manufacture, who have had the two types to deal with.

In the writer's opinion, it is generally a question of adopting either the open type or the totally enclosed type, the ventilated enclosed type being left to those jobs where the fire insurance regulations necessitate them.

In conclusion, this question of motor driving, as to the most suitable type of motor for particular jobs, &c., is one which has to be gone into in each individual case, and one which has to be answered by past experience on the subject.

The experience and actual causes of successes and failures in this particular line have been entirely in the hands of the larger manufacturing firms at present, and provided their advice is taken on the subject there is no question that motor driving in our factories, iron and steel works, collieries, and ship building yards, will go straight ahead. There is, however, a fear that if the average consulting engineer in this country gets hold of the business in the same way that he has got hold of the lighting industry, the application of motors for power purposes may receive a severe rebuff, which will temporarily check progress pending the time that the consulting engineer gains his experience and rectifies his faults. If motors are judiciously applied they introduce great savings, but if, on the other hand, they are applied at random, it is only too easy to spend capital without being able to show an adequate return, and this, more than anything, is likely to harm the industry.

The great difference between an electric lighting plant and a factory plant is, that anyone can find out and learn what has been done in the former, whilst only those actually engaged on the job can know what is going on in the factory, and hence experience has to be gained slowly, and, in some cases, at considerable cost.

LONDON COUNTY COUNCIL.

The Council, at the meeting on Tuesday, resolved to lend £25,000 to the Fulham Vestry for electric lighting purposes, and £14,620 to the Shoreditch Vestry for a site for a new generating station.

The New Generating Station.

The adjourned report of the Highways Committee, to which reference was made in our last issue, was again brought forward. It may be remembered that the Committee recommended the Council to seek powers in the London County Council Tramways (Electrical Traction) Bill for the compulsory acquisition of the freehold of the leasehold portion of the tramway depôt at Camberwell, and of certain adjoining property, for the purpose of a site for the erection of a generating station for the working of the tramways.

Mr. J. W. Benn, chairman of the Committee, asked the Council to postpone the consideration of the question for a week. This was agreed to, although no explanation was given as to the reason for taking that course.

London United Tramways.

It was reported by the Highways Committee that the London United Tramways Company had submitted for approval detailed drawings for the equipment on the overhead trolley system of the tramways in the Uxbridge Road, between the Askew Arms public house and the Uxbridge Road railway station, and between the railway station and Young's Corner, and, by an underground system, of the tramways from Young's Corner to Hammersmith Broadway, and thence along Beadon Road, Glenthorne Road, and Studland Road, and that part of The Grove between Beadon Road and King Street West. The Vestry of Hammersmith had strongly urged that an overhead system should be adopted for the tramways in King Street, Beadon Road, and Glenthorne Road. In support of this suggestion the Vestry pointed out that King Street is narrow, and inconvenience would be caused to shopkeepers and the public during the construction of an underground system; while the District Railway runs under Beadon Road for a distance of 127 yards, and there would be a difficulty in laying a conduit system there, owing to the fact that there is only a space of between 9 and 12 inches between the top of the girders of the railway tunnel and the surface of the road.

The Highways Committee stated, however, that they were advised that having regard to the provisions of the Act and the agreement with the company, the Council had no power to agree to the adoption of the overhead system for the tramways in King Street, Beadon Road and Glenthorne Road, and that as the company were prepared to adopt an underground system, notwithstanding the difficulties to be met with in its construction, the Committee were of opinion that no reason existed for the Council to withhold consent to the plans submitted. The Committee further said:—

The company states that the designs for the electrical conduit are similar to those of the system in operation on the metropolitan tramways in New York, but certain improvements have been made in the details which render the system more suitable for the special conditions under which the tramways are to be operated; and the detailed plans submitted of the proposed system of double-trolley overhead system show that in connection with it there will be no uninsulated return, and thus a great objection to the system, generally used, with a rail return, is removed. The plans show that the wires are to be placed only 22 feet above the level of the rails, although the Council's bye-laws under the London Overhead Wires Act, 1891, require the height to be 35 feet. 22 feet is, however, the usual height for such wires in connection with tramway traction; and the Fire Brigade Committee, whom we have consulted in the matter, has raised no objection to the wires being placed at the height proposed, nor has any objection to the height been raised by the Vestry. We are advised by the engineer, who has been in communication with Dr. Kennedy on the matter, that the plans and details may be approved by the Council subject to certain conditions.

The Committee accordingly recommended the Council to approve of the plans subject to the following conditions:—

That the trolley wires be not attached to the electric lighting standards of the Vestry of Hammersmith; that the company do furnish to the Vestry detailed drawings of the inspection chambers and boxes proposed to be placed in the carriageways or footways; that the "Bristol" designs for the side and centre traction posts be used; that the cut-out circuits be of such length as shall be approved by the Council's chief engineer; and that the company do submit for the approval of the Council an amended design for the conduit.

The consideration of the recommendation had, however, to be postponed, in view of the opposition being raised at a late hour of the sitting.

Post Office Telephony.

In connection with the scheme for providing a State telephone system in London, the Highways Committee announced that—

App'ication had been made on behalf of the Postmaster-General for the Council's consent to the erection and maintenance of staging to support lead-covered telegraph wire cables in Queen Victoria Street and Victoria Embankment subways, between the Post Office Savings Bank in Queen Victoria Street, and a point opposite the Temple railway station, and also between Northumberland Avenue and Westminster Bridge, such consent to include all necessary work for connecting the cables with the underground pipes on the Embankment at Middle Temple Lane, the Temple railway station, Northumberland Avenue and Westminster Bridge, and for leading the cables into the Savings Bank.

It appeared that the subways in question are becoming fully occupied, and the Committee stated that modifications of the drawings might be found necessary in order to secure that the greatest possible use was made of the limited space in the subways. Subject to certain conditions specified by the Committee, the Council decided to grant the desired permission.

Prevention of Boiler Explosions.

It was unanimously resolved, on the recommendation of the Public Control Committee, to address a letter to the Board of Trade suggesting the desirability of a Select Committee being appointed to inquire into the causes of boiler explosions and the means to be taken for their prevention. The decision was arrived at as a result of the following report of the Committee:—

Our attention has been directed to the explosion of a boiler which occurred in the early part of the year at Barking, by which a number of persons lost their lives, and others were seriously injured, and we have had under consideration the question of what measures appear to be desirable with a view to preventing similar explosions in future. We find that under the existing law the Board of Trade have power to make inquiry into the causes of boiler explosions, but no public authority has any power to periodically inspect boilers with a view to the prevention of accidents. The question has, however, been frequently before Parliament, and for some years past Bills have, session after session, been introduced (1) for the purpose of regulating and controlling steam boilers; and (2) to provide for the examination and certification of persons in charge of such boilers. We have had before us a return showing that during the 16 years since the passing of the Boiler Explosions Act, 1882, there have been reported 1,121 boiler explosions, by which 466 lives were lost, and 975 persons were injured. We are of opinion that this considerable loss of life and injury to persons can, in a large measure, be prevented by the periodical examination of boilers by competent persons, and of empowering public authorities to condemn such boilers as are reported to be unsafe.

CORRESPONDENCE.

Insulation Resistance.

I have just completed an electric light installation of some size in a technical school that has been in use for a year or two, and I have been surprised to get an extremely high insulation resistance, vouched for by the Corporation electrical engineer, the result is as follows:—

There are over 600 lamps fixed in 522 different positions and controlled by 189 different switches, and the insulation resistance vouched for is 2 megohms, or, as you will see, at the rate of 1,044 megohms divided by the number of lamps.

I have not been sufficiently long in this country since my return from America to ascertain what the highest requirements per lamp are, but I believe that in no supply they exceed 100 megohms per lamp. I therefore believe that in the case referred to above, I have established somewhat of a record for insulation resistance, or, what is sometimes called in architect's specifications, "installation resistance."

I shall be glad to hear from you, or from any of your readers, of any similar high or higher tests that can be vouched for.

D. J. Callow.

October 25th, 1899.

600-kw. Inductor Alternator.

With reference to your article in last week's issue on the 600-kw. steam inductor recently supplied and set to work by the Brush Company, I notice that you mention the steam consumption, 27¼ lbs. per kilowatt-hour. As this is not by any means a record steam consumption for a compound engine, may I point out that the usual arrangement, in which the engines are in one row and the boilers in another, with merely a wall between them, is not adopted; in fact, the shape of the station is such that the plant is arranged in three rows, the steam crossing the first and second rows in order to reach this plant, which stands alone and further from the boilers than any other plant in the station. The bearing that this fact has on the steam consumption needs no comment to steam engineers, and it was so far appreciated by the Brush Company when tendering that they declined to guarantee better results than 30 lbs. per kilowatt-hour. The result obtained must therefore be considered thoroughly satisfactory, particularly as the vacuum from the independent condenser was only 22 inches.

The Brush Electrical Engineering Company, Limited.
R. A. Dawsarn,
Superintending Engineer.

October 27th, 1899.

Babcock & Wilcox Superheater.

Permit me to draw attention to an article in your last issue headed the "Babcock & Wilcox Superheater," written with a view to correcting "a serious mistake" in another paper. The writer assumes that the formula $\frac{T_1 - T_2}{T_1}$ can be applied directly to an engine using superheated steam, T_1 being taken as the temperature of the latter. Now, in the reasoning by which the above formula for the maximum efficiency of a heat engine is arrived at, the whole of the heat is supposed to be received at the higher temperature, T_1, whereas, in the case of a boiler with a superheater attached, the greater part of the heat is received at the temperature of the boiler, and a comparatively small quantity at higher temperatures in the superheater. To take the case quoted in your paper, where steam at 100 lbs. pressure receives a superheat of 125° F., boiler temperature is 337° F., and the temperature of the superheated steam 462° F.

Taking the feed to be at 212° F., the heat taken up in the boiler is over 1,000 thermal units per pound of steam; superheating this pound of steam 125°, the specific heat of steam at constant pressure being 0·48, involves the addition of 60 thermal units.

The increase of the theoretical efficiency, due to some 6 per cent. of the total heat supplied being taken in at temperatures between 337° and 462° instead of at 337°, is obviously quite insignificant, and turns out to be something like 2 per cent. instead of 72 per cent., as stated. Of course, a very substantial increase of efficiency, due to superheating, is obtained in actual practice by the removal of the losses due to initial condensation.

William Tatlow.

Fog Signalling on Railways.

I am much pleased to see your article this morning under this heading, and to find that you are lending your powerful assistance to the purpose for which I also am working, viz., inducing the railway companies to make a combined and thorough investigation of the subject, with a view to determining if it is not now possible to improve upon methods which Sir Douglas Fox says "cry aloud for reform," Sir William Preece calls "barbarous, dangerous, and irregular," Mr. W. M. Acworth considers "primitive," and you now characterise as "antiquated."

At the engineering conference last June I urged that a committee should be appointed to formulate a list of requirements, consider plans submitted, and give a thorough practical trial to any methods that they might consider sufficiently promising. This, I think you will agree with me, is the proper way of proceeding in a matter where it is necessary that all the companies shall use the same system.

Permit me to take this opportunity of thanking you for your full and careful report of my recent paper submitted to the British Association.

I should be much obliged if you would kindly allow me to point out, as a postscript to the paper, that in the case of tender engines it is not necessary that any of my apparatus should be fixed on the engine itself. The armatures, batteries, &c., may all be put on the tender, the indicator being attached to the end of a suitable length of flexible

cable, so that it may be detachably placed where desired in the cab of the engine.

Whenever it becomes necessary to separate engine and tender for overhauling, the indicator can be lifted down and safely stowed away in a box provided for the purpose on the tender, without necessitating the undoing of a single electric connection, or the attendance of an electrician. When the engine is ready to go out again, it is only a moment's work to take out the indicator and hook it on to its bracket again.

W. S. Boult.

Improved Trolley Pole.

Referring to your note on page 684 on an improved trolley pole, I should like to ask what holds the trolley against the wire when the car is standing or drifting, and there is consequently *no* main current. The arrangement as described seems very good as far as it goes, but apparently it does not go far enough.

W. H. I.

[The note referred to was, as stated, quoted from a contemporary. The difficulty to which our correspondent draws attention might be overcome by using an electromagnet excited in shunt between the trolley wire and earth. —Eds. Elec. Rev.]

Arc Lamps and How to Maintain Them.

In reference to your criticism of our book, "Arc Lamps and How to Maintain Them," we should like to make the following remarks :—

1. It must be remembered that the book is intended for people who have no technical training, but who, nevertheless, re-carbon the lamps and do slight repairs to them. Hence the absence of illustrations, as these people, when in difficulties, have the lamp actually in hand, and it is easier for a man who does not know how to read a drawing, to follow the directions in the book, on the lamp itself. Also, this book is not intended for an advertisement for the arc lamps described in it.

2. On page 13, dealing with two lamps in series, only one of which lights up, "no circuit" is a mistake which will be rectified in the next edition.

3. "The kilowatt is repeatedly called a unit." What is the use of writing about kilowatts for a man who does not understand the term ? This book is not an electrical textbook, nor a glossary ! On the other hand, all arc lamp trimmers are in the habit of speaking of "electrical units."

4. What is a short circuit ? Obviously, not an infinite leakage of current, as no dynamo yet made, gives infinite current.

5. Perhaps our critic has never heard of the very common usage of incandescent lamps to indicate leakages. If so, we know several dynamo attendants (men who are not usually credited with a vast amount of electrical knowledge) who could enlighten him on this point.

6. The length of an open arc cannot be dealt with here without much discussion ; but we must take exception to the very emphatic manner in which our critic denies the accuracy of our statement. All practical arc lamp manufacturers know that the length of arc varies with the voltage employed on the lamp and the quality of the carbons. We maintain that for 43 volts, 10 amperes, and good French or Belgian carbons, $\frac{3}{32}$ inch is a very general length of arc.

7. In reference to an enclosed arc burning in a partial vacuum, although more might have been said as to the consumption of the oxygen in the "envelope," we would ask our critic, "Has he satisfied himself that an enclosed arc burns in a plenum ?"

8. Has our critic ever seen 15 mm. positive and 11 mm. negative carbons used in 10 or 12-ampere lamps of the different sorts we have described ? Messrs. Crompton & Co. use 18 mm. and 12 mm. carbons; Messrs. Royce & Co. use 18 mm. and 11 mm. carbons; and Messrs. Körting and Matthieson use 18 mm. and 12 mm. carbons and 18 mm. and 11 mm. carbons. We will go further, and ask, Has he ever seen 15 mm. and 11 mm. carbons burnt together when both are of the same length in the foregoing types of lamps ? If so, we surmise that there would be a busy time for the attendant in replacing burnt carbon holders. Further, we may mention that, in Manchester alone, there are at least 500 arc lamps taking 10 amperes at 43 volts and using 18 mm. and 11 mm. carbons, and that these carbons burn evenly as to length, and last 14 hours.

H. Smithson,
E. R. Sharpe,
Per Smithson, Sharpe & Co.

[Following our correspondents' example, we will deal with the points raised in order :—

1. We still maintain that the usefulness of the book is diminished by the lack of illustrations, which need not be complicated ; the possibility of advertising rival manufacturers' lamps ought not to have weight in the matter.

2. This error is admitted by the authors.

3. The authors *themselves* introduced the word "kilowatt," which they now say is too lofty for their readers ; *e.g.*, on page 15, "the price of a kilowatt or unit varies in different towns." On the same page they say—" . . . . This equals 1,000 watts or one unit, and if the price of a unit is 5d. . . . . ;" the same error also occurs elsewhere. If arc lamp trimmers are ignorant, must authors pander to their ignorance ? Must we drop our h's when we speak to Hooligans ?

4. We cannot understand what our correspondents are driving at ; we quote the text : "When there is a large leakage of this kind, a short circuit is said to occur." This in a paragraph about *insulation* !

5. We said "leakage from one wire to another, or a short circuit ;" the original text we give in full :—" . . . . an earth. To indicate this, *or a short circuit*, incandescent lamps are sometimes fixed on the switchboard, and so wired, that a *leakage from one wire to another*, or from the wires to 'earth,' lights the lamps. The amount of light they give roughly gauges the leakage." (The italics are ours.) The use of glow lamps to indicate leakages *to earth* dates from the earliest days of electric lighting ; but how they are employed to show leakage *from one wire to another*, or a short circuit, we do not know. Are they inserted in series with the leakage path ? (!) We grant that when a short circuit occurs the lamps usually go out ; we suggest, therefore, that for "the amount of light" in the above quotation, our friends should substitute "the depth of darkness."

6. We repeat that $\frac{3}{32}$-inch is too short for an open arc. Of course, an arc will burn at various lengths ; but when the arc is too short, there is a great loss of light, and the feed must be very delicately adjusted.

7. An enclosed arc burns under atmospheric pressure, *i.e.*, neither in a plenum nor in a vacuum. This is undeniable.

8. On this point our correspondents marshal an array of facts which we are not prepared to dispute ; we may, however, mention that our reviewer was handling and testing arc lamps years before the 10 years' experience of the authors commenced, that he has designed arc lamps, and has superintended the running of numerous types.—Eds. Elec. Rev.]

Consulting Engineer or Tradesman ?

Is a "consulting engineer" a tradesman, and as such entitled to trade terms from supply houses such as ourselves ?

We conclude that if such a question had been addressed to yourselves in your non-editorial capacity, or for the matter of that, to any of the numerous professional gentlemen who practise as consulting engineers, the answer would be a most distinct negative, if, indeed, you did not feel that the insolence of the inquiry demanded rather more forcible treatment than simple words. But it is to the Editors of the Electrical Review, and through them to their numerous readers, that we administer the interrogatory, the question having been raised in our mind by the increasing use which is being made of the title of consulting engineer by persons who, at the same time, are not at all averse to receiving the profits which rightly belong to the contractor, and more particularly by the correspondence which has lately passed between ourselves and a gentleman who so designates himself.

We ourselves have thought it our duty to protect our *bonâ fide* trade customers from such competition, believing that the consulting engineer should be content with his con-

sultation fees, and that he was in no way entitled to run with the hare and hunt with the hounds.

In case you may think this matter of sufficient importance to devote the necessary space to the publication of the correspondence, we enclose a copy of it; of course, suppressing all names, particularly those of the two well-known firms who are mentioned as giving trade terms.

The Stewart Electrical Syndicate, Limited,
Per Douglas C. Bate, *Managing Director*.

COPY OF CORRESPONDENCE.

October 27th, 1899.

——— ———, M.I.J.E.,
Consulting Engineer.

The Stewart Electrical Syndicate, Limited,
London.

Dear Sirs,—I shall be obliged if you will let me have your list of *small* and *ordinary* size enclosed lamps for continuous current; and do you make them inverted? Also please let me know best trade terms, and should like list by return.

Yours truly,
(Signed) ——— ———.

5, New Compton Street, W.
October 28th, 1899.

——— ———, Esqr.,
——— ——— ———.

Dear Sir,—In reply to your esteemed favour of yesterday's date, for which we thank you, we are sending by this post a copy of our price lists of "Stewart" enclosed arc lamps for continuous current, and on receipt of your statement of requirements, shall be pleased to quote you our discounts for quantities.

We regret that we are unable to quote you our trade terms, which, as you are not in the trade, would be unfair to those who are.

We are, dear Sir,
Yours faithfully,
For the Stewart Electrical Syndicate, Limited,
(Signed) Douglas C. Bate, *Managing Director*.

October 28th, 1899.

Messrs. The Stewart Electrical Syndicate.

Dear Sirs,—I was rather surprised to get yours of 28th, saying I was not in the trade, and you could not allow me trade terms. If you refer to ——— ——— or ——— ———, of London, you will find that I have dealt with them for years, and have had the very best terms. Of course, if you are so dense, I can buy elsewhere.

Yours truly,
(Signed) ——— ———.

October 30th, 1899.

——— ——— Esq.,
——— ——— ———

Dear Sir,—We are duly in receipt of your favour of 28th inst., for which we thank you, but can hardly plead guilty to your charge of "density," inasmuch as we have the authority of the printing at the head of your own letter paper for believing you to be a "consulting engineer." However, the mistake is not a vital one, and if you are entitled to trade terms, you can obtain them from ——— ——— ———, to whom you say you are well known.

We are, Dear Sir,
Yours faithfully,
For the Stewart Electrical Syndicate, Limited,
(Signed) Douglas C. Bate, *Managing Director*

[The question which our correspondents address to us turns, we think, upon definitions; we therefore give our definitions first and our views afterwards:—

Consulting Engineer—One who impartially advises non-technical customers on what and where to buy.

Tradesman—One who buys and sells for profit; strictly speaking, a retail dealer.

Our opinion, then, is that a consulting engineer is *not* a tradesman; he is, however, in the trade, and is accordingly entitled to trade terms when he buys articles *for his own use*. Should he sell any apparatus at a profit, he is no longer a consulting engineer in the ordinary acceptation of the term. We entirely approve of our correspondents' action in refusing trade terms to the self-styled "consulting" engineer, who obviously intended to resell the lamps, and who seems to be, in fact, "consulting" his own interests!—Eds Elec. Rev.]

BUSINESS NOTICES, &c.

Answers to "Situations Vacant" Advertisments.—The man who answers advertisments of "Situations Vacant" is too often blind to his own interests. He can hardly expect his application to meet with success unless he furnishes the information which the advertiser stipulates as necessary. We have reason for believing that failure to state experience, and to give references, has sent many a letter the way of all waste paper. The man at liberty, generally, would have no reason for withholding these particulars, but to the man anxious to better his present position in life there may be feelings that he would like to take his chance without showing his hand too much at first, and trust to providence to make it lead to something. Ninety-nine out of every hundred applications of this class are not replied to. It is in the interests of applicants, that we remind them that all information of the kind referred to is considered "private and confidential" by the recipient. The National Electric Free Wiring Company, which has lately been advertising for men, has received a whole host of letters in which the fatal omission has been made. The matter merely needs mention to lead to its rectification.

Electrical Wares Exported.

Week ending Nov. 1st, 1898.		Week ending Oct. 31st, 1899.	
Adelaide	Value £51	Adelaide	Value £268
Alexandria	40	Alexandria	90
Amsterdam	207	„ Teleph. mat. ..	54
Antwerp	35	Bangkok	49
Bangkok	207	Boca	1,168
Bombay	486	„ Teleg. mat.	409
Boulogne	216	Bombay	147
Buenos Ayres	823	„ Teleg. wire	59
„ „ Teleg. mat. ..	474	Brisbane	16
Calcutta	188	Buenos Ayres	750
Cape Town	271	„ Teleg. wire ..	479
Christiansand	46	Calcutta	276
Colombo	59	Cape Town	410
Constantinople	14	Christiania. Teleg. wire ..	86
Durban	135	Colombo	1,029
East London	10	Copenhagen	263
Gothenburg	46	Durban	16
Hamburg	50	„ Teleg. wire mat. ..	4,168
Malta	47	East London	558
Ostend	45	Gothenburg	30
Otago	63	„ Teleg. wire ..	15
Paris. Elec. batteries	25	Hong Kong	15
„ Elec. fuses	75	Madras	16
Port Elizabeth	18	Monte Video. Teleg. mat. ..	72
„ „ Teleg. mat. ..	180	North Sea. Teleg. cable ..	2,200
Rangoon	49	Port Elizabeth	151
Rio Janeiro	186	Port Said	39
Santander	7	Santos	38
Spezzia	121	„ Teleg. mat.	172
Stockholm	613	Sydney	251
Sydney	446	Valparaiso	112
Tientsin. Teleg. mat.	80	Venice. Elec. launch machy...	500
		Vera Cruz	90
		Wellington	370
		Yokohama	140
		„ Teleg. cable ..	566
Total ..	£4,818	Total ..	£15,161

Foreign Goods Transhipped.

Hong Kong.	Elec. plant .	Value £50
Melbourne.	Elec. motors ..	100
	Total	£150

Auction Sale.—From our small advertisements may be gained particulars of an auction sale which will take place on Thursday, November 16th, at Birmingham, of the acetylene works, Corngreaves, Cradley Heath, together with the goodwill and electrical equipment, used in the manufacture of carbide of calcium.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court held last week before Mr. Registrar Hope, John G. M. Hilton, electrician, attended for public examination upon accounts showing liabilities £2,026 13s. 8d., and assets consisting of 4,500 fully paid, and 3,000 half paid £1 shares, which are now regarded as possessing no apparent value. The bankrupt states that in January, 1895, he became one of the managing directors of the Nalder & Harrison Construction Syndicate, in which company he invested £2,250 (money derived principally from his father's estate), but shortly afterwards the syndicate went into voluntary liquidation. He then, in conjunction with another person, purchased the electrical portion of the business, and carried on the same until early in 1897 (the bankrupt putting into the business capital to the amount of £2,000, which he obtained from the trustees of his marriage settlement); at the latter date the business was formed into a limited company, with a nominal capital of £20,000, the partners, as vendors, receiving £9,000 in fully paid shares and £6,000 in partly paid shares, and continuing to manage the business. In March, 1898, however, in consequence of a disagreement, he retired from the company on the terms that he should be entitled to £800 cash (which was to be used to reduce his liabilities in connection with the late firm) and £1,200 in six annual instalments, half of which he capitalised for £300. In January, 1899, he returned to the business and introduced a further sum of £400 (advanced him by his wife's relatives), but in May last the company went into voluntary liquidation. He attributes his insolvency to the failure of the company in the manufacture of electrical apparatus, and to his own want of business experience. The examination was ordered to be concluded.

A receiving order has been made at the London Bankruptcy Court against the estate of E. Max Winter, electrical engineer, Amberley House, Norfolk Street, Strand. The petition was presented by Messrs. H. Clarkson & Son, solicitors, acting on behalf of Mr. Wm. Prebble, surveyor, Bromley, the act of bankruptcy alleged being non-compliance with the requirements of the usual notice. No particulars transpired with regard to assets or liabilities.

Liquidations, Dissolutions, &c.—Messrs. J. Lovelock, A. J. Seabourne, and A. M. Lee (Lovelock, Seabourne & Lee, engineers and electricians, 8, Jeffrey's Square, St. Mary Axe) have dissolved partnership.

Messrs. G. E. Belliss & Co., Limited, met on September 27th and October 24th, at Birmingham, and passed resolutions approving of the reconstruction scheme and the terms of the agreement for the sale of the company to Belliss & Morcom, Limited. Mr. J. E. Rubery, of 17, Newhall Street, Birmingham, is voluntary liquidator of the company.

Creditors of Elmore's Foreign and Colonial Patent Depositing Company, Elmore's Patent Depositing Company, and Elmore's Wire Manufacturing Company, must send particulars of debts or claims, &c, to the liquidator, Mr. J. Shurmer, Greek Street Chambers, Park Row, Leeds, by December 9th.

For the purposes of reconstruction, Messrs. F. H. Royce & Co., Limited, are winding up voluntarily. Mr. F. H. Royce, of Brae Cottage, Legh Road, Knutsford, and Mr. E. A. Claremont, of Endsleigh, Legh Road, Knutsford, are liquidators. The new company will be known as Royce, Limited. The registration notice appeared under our "New Companies" last week.

A petition for the winding up of Maudslay, Sons & Field, Limited, presented by Major J. H. E. Allen, creditor, will be heard by Mr. Justice Wright, in the Winding-up Court, on Wednesday, November 8th.

A meeting of Nernst Lamp, Limited, is to be held at Dashwood House, E.C. on December 4th to hear an account of the winding up from the liquidator, Mr. Wm. Chaplin.

Books Received.—"Magnetism and Electricity," by J. Paley Yorke. London: Edward Arnold. 3s. 6d.

"Fire Tests with Glass," No. 30, by the British Luxfer Prism Syndicate, Limited, and No. 31 by Messrs. Pilkington Bros, Limited. London: British Fire Prevention Committee. 1899. 2s. 6d. each.

"Fowler's Mechanical Engineers' Pocket-Book," 1900. Manchester: Scientific Publishing Company. 1s. 6d. net.

"Manual of Electrical Undertakings," 1899-1900, by Emile Garcke. London: W. Alderson Smith. 12s. 6d. net.

"The Manufacture of Carbons for Electric Lighting and other Purposes," by Francis Jehl, M.Am.I.E.E. London: The *Electrician* Printing and Publishing Company. 10s. 6d.

Brougham v. Bateman. — Before his Honour Judge Lumley Smith, Q.C., in the Westminster County Court last week, the Hon. Reginald Brougham, electrical engineer, sued Messrs. Bateman, engineers, for the return of a deposit of £10 and damages for the non-completion of an order. The case for the plaintiff was that he went to defendants' premises in Holborn, and there saw Mr. Bateman about some plans and models of some automatic couplings for railway purposes he had designed and provisionally patented. He told him he wanted the working drawing within a week, as a Parliamentary Committee was sitting on the subject, and he wanted to get the matter on as quickly as possible. Mr. Bateman agreed to do it and make models of the couplings. He sent £10 deposit at the request of Mr. Bateman. He wished the thing to be hurried on as there were hundreds of electrical engineers devising schemes for automatic couplings, and the Parliamentary Committee was sitting. A number of frivolous excuses were made for delaying the whole matter, and eventually plaintiff asked for his money back, countermanding the order. He could not get his money back, and he had been put to a great deal of trouble. The defence was that the drawing was supplied in the time specified, but was returned by the plaintiff for alteration, and an employé of the defendants' took it away. A prosecution followed and that delayed the order. Two model trucks were now produced, minus couplings, and their value was said to be £6 10s. The time spent on the order was worth £3 or £4 in addition. The order would have been completed if plaintiff had not stopped them. His Honour said there had been an unfortunate delay owing to a disagreement between Mr. Bateman and his employés, as shown by the correspondence in the case, but that was a risk he took, and customers were entitled to have their work in the ordinary way. To have made the trucks before the couplings was premature, and he thought the plaintiff was entitled to recover on his claim for the return of the deposit, less £1 for the plan, which would be a judgment for the plaintiff for £9 with costs.

Catalogues and Lists.—Mr. Frederic Nell, of Queen Victoria Street, E.C., has published a new catalogue of Smith-Vaile pumping machinery, the Victor turbine, condensing and compressing plant, &c. The 208 pages are divided off into eight different sections as follow:—(1) Duplex steam pumps; (2) single cylinder steam pumps; (3) artesian well and vertical mine pumps; (4) triplex and duplex (single and double acting); (5) jet and surface condensers (air, vacuum, and air circulating pumps); (6) centrifugal pumps; (7) air compressors; (8) turbines. There is a number of illustrations, both photographic and diagrammatic, which give additional interest to the descriptions which accompany them. Section 8, of course, has a good deal of matter, tabulated and otherwise, relating to the "Victor" turbine, tests, table of dimensions, and several pictures show various sizes and styles of these turbines as employed by the Edison Electric Illuminating Company, of Spokane Falls, Wash., and other American works. The Geisler electro-mechanical governor for regulating the speed of water wheels, and the same governor, with motor attached, for operating an automatic waste gate, and some general information relating to water-power, are among the contents of this catalogue.

The Noiseless Gear Company, of Levenshulme, send us a list of their machine cut double helical gear wheels.

Messrs. Gambrell Bros., of Giltspur Street, E.C., have sent us one of their illustrated "B" lists of scientific instruments, including resistance coils and boxes, reflecting galvanometers, direct reading galvanometers, testing sets, switches, &c. Prices and illustrations are given.

From the Electrical Company, Limited, we have received a reference list of various direct, alternating, and three-phase dynamos and motors supplied by them to firms in London and the provinces. There are 467 machines of 3,213 total B.H.P.

Electrical Copper Company v. The Commercial Bank of Scotland.—In the Queen's Bench Division on 27th ult., before Mr. Justice Bigham, sitting without a jury, the case was heard of the Electrical Copper Company, Limited, *v.* The Commercial Bank of Scotland, Limited, both carrying on business in the City. The action was brought to recover £1,696, the proceeds of the sale of 25 tons of copper, against which the Bank of Scotland held warrants as security for certain loans. The point raised was whether such warrants were negotiable instruments, and whether Mr. Robert Mortimer Moir, the managing director of R. M. Moir & Co., Limited, in obtaining a loan as against one of the warrants, acted as a mercantile agent. After the hearing had proceeded for a while, his Lordship stopped the case and said that further evidence was not necessary for the purposes of a legal decision. After consultation, Mr. Joseph Walton, Q.C., announced that his clients had agreed to settle the case without prejudice to their rights against a third party, who had guaranteed the bank against loss. It had, he said, been agreed that the bank should retain £1,000 and the plaintiffs should take the balance of £696, each party to pay their own costs.— Judgment accordingly.

Electrical Engineering in the Celebes (Dutch Indies).—The formal opening of the machinery which was sent out to the North Celebes Mining Company in April, took place at Soemalata on September 9th. Among the company present were Mr. Dane, the mining engineer, Meinherr De Steurs, administrator, Meinherren Van Riaw, Crickmayer, Heinrichs, Barber, Dr. Vinkhuizen, Mr. Penaluns, Herr Loesche, the erector of the engine, and the two engineers responsible, viz., Mr. Robinson, of London, and Mr. Wilfrid Bowman, of Liscard. In opening the plant Mr. Dane spoke in high terms of the indefatigable manner in which the work had been carried out, and said that considering the great local handicaps, it constituted a record for that part of the world. Since the opening in September the machinery has been working regularly and in a thoroughly satisfactory manner. The plant consists of one engine by Langensiepen, of Magdeburg, one dynamo by Siemens & Halske, one dynamo by the Allgemeine E. G. and six motors, together with the mining machinery by Siemens & Halske. There has also been erected a fitting shop containing a lathe with 15-inch centres and 14 feet bed, drilling machine, &c.

Electrical Engineering in Italy.—The plant of the Società Piemontese per la Fabbricazione del Carburo di Calcio, at St. Marcel, is about to be enlarged by the addition of five 404-KW. tri-phase alternators. The contract for the same has been placed with the Società di Elettricità (Schuckert & Co.), of Milan.

Electrical Works at Tipton.—Our Wolverhampton correspondent says that the Exploration Company, of Cornhill, London, have purchased about 14 acres of land at the foot of the pumping station on the canal side at Ocker Hill, Tipton, as a site for new electrical works. The intention of the company—of which Mr. Thomas Parker, of Wolverhampton, is one of the directors—is to put down a plant of 10,000 H.P. for the purpose of supplying electricity to manufacturers of driving machinery and lighting, and also to local authorities in the district for illuminating the streets. It is stated several well-known London capitalists are identified with this new enterprise. Presumably this is the scheme of the Midland Electric Corporation for power distribution.

Factory Lighting.—Messrs. Ellis & Ward, of Birmingham, have secured the order for the electric lighting of the large bedstead factory of Messrs. Wale & Sons, of Birmingham. The consulting engineers are Messrs. Cerrito, Edwards & Shaw, of Birmingham.

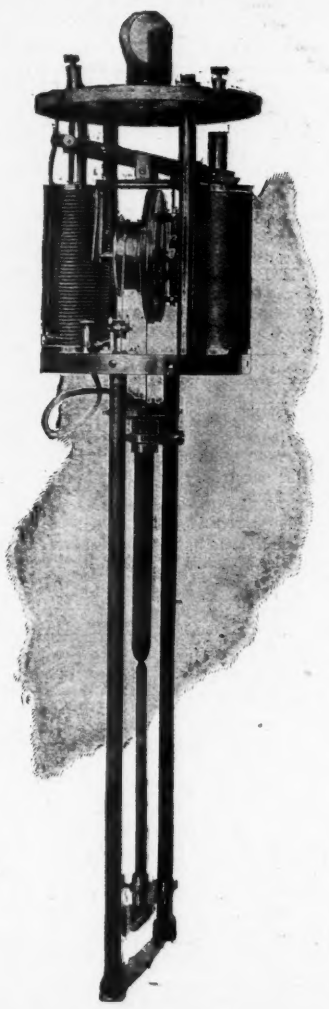
The Madras Electric Tramways Company, Limited.—On Wednesday last (November 1st) Mr. Justice Wright, sitting in the High Court of Justice as an additional judge of the Chancery Division for the transaction of companies' winding up business, had before him the petition of the Electric Construction Company, Limited, for the winding up of the Madras Electric Tramways Company, Limited. The matter had been last mentioned on August 9th, before the long vacation. Mr. Eve, Q.C., who appeared for creditors, claiming altogether £32,000, said that as the defendant company had in the interval done nothing, his clients were entitled to an order for winding up. On the other side, Mr. Herbert Reed, Q.C., appeared, and stated that a question of interest was in dispute, but it was hoped that negotiations would be renewed, and that some result might be arrived at. Petitioners were debenture holders and mortgagees, they were the owners of everything connected with the company, and were collecting its fares, which were largely on the increase. Counsel also mentioned that the shareholders in the Madras Electric Tramways Company included many of the native residents. —Evidence having been heard as to the present position of the company, the matter was ordered to stand over for a fortnight.

The Metropolitan Electric Supply Co.—The *Indicator* says that a circular has been issued by the Metropolitan Electric Supply Company, in which they express regret that they have recently been unable to maintain a satisfactory supply of electricity during all hours of demand. The company's new works at Willesden, fitted up with machinery of unusual magnitude, and of the most modern construction, have just been completed. The directors of

the company in their circular, express the hope that they will shortly be able to fully meet the demands made upon them for electricity.

Mica Manufacturing Company.—Last week Mr. Justice Byrne granted an application on behalf of Mr. Kirkwood that the register of the above company might be rectified by the removal of his name as the holder of 340 shares on the ground that he never applied for them.

New Arc Lamp.—The Electrical Transmission Company, Limited, of Albert Works, Hammersmith, are now putting on the market a new arc lamp, as shown in the accompanying illustration. The lamps can be supplied with cases or globes of any pattern, or in lanterns, to suit requirements. The figure gives a view of the lamp mechanism. This consists of main and shunt solenoids which actuate a rocking lever, which in its turn acts upon a friction clutch by means of which the arc is struck, and the feeding controlled. The friction clutch is of such an effective design that the lamp can be subjected to any amount of shaking or vibration without the arc



being in any way affected. The carbon holders work along the slides on small rollers which prevent sticking and give smoothness of movement. The lower carbon holder is connected to the cross-bar by a simple form of ball joint enabling the carbons to be easily adjusted. We are informed that the Electrical Standardising, Testing and Training Institution, who have examined and tested the lamp, report that the arc strikes quickly and well, and with no objectionable flickering before settling down, and that the lamp runs with great steadiness, the regulating mechanism working with uniform smoothness. The lamps are constructed to work on either continuous or alternating current circuits. Owing to the simple character of the design of the lamp, and the arrangements which the Electrical Transmission Company have made for its manufacture, the price is said to be moderate.

Smoke Nuisance.—At the South Western Police Court, the County of London and Brush Provincial Electric Lighting Company has been summoned at the instance of the Wandsworth District Board of Works, for allowing black smoke to issue from the chimney shaft at their works, the Causeway, Wandsworth.—Mr. W. W. Young, the Board's solicitor, reminded the magistrate that the company had been convicted several times of a similar offence, and appeared to take no trouble to abate the nuisance. During the Welsh coal strike there was some excuse for the defendants, but there was no reason why, with the use of the best coal, and effective supervision over the stoking, the nuisance should not almost entirely have disappeared.—Evidence was given by Sanitary Inspectors Hatton and Weekes, and by an inspector under the Society for the Abatement of the Smoke Nuisance, respecting various occasions on which the smoke was seen to issue in great volume from the chimney.—Mr. Whitlock, the chief engineer of the works, suggested that the smoke was not so black as the witnesses had made it out to be.—The magistrate imposed penalties amounting in all to £45.

"Sparkless Gem" Dynamo Brushes.—Mr. S. Jevons, of the Electrical Engineering Stores, Minories, Birmingham, is the sole licensee for the United Kingdom for the sale of the brushes mentioned in the title of this notice. The brushes are stated to be very popular on the market. They are made under Chaplin's patents, and are the result of constant improvements necessitated and suggested by evolution of the electric generator. Badly constructed current collectors will soon cause the most perfect dynamo to go wrong; yet a poor and worn out machine has been made to nearly double its output by a change of brushes, enabling it to run cool and clean at this point. A true test for the efficiency of a brush is the temperature of the commutator running under it: and the claims in favour of the "Sparkless Gem" brushes are based on the fact that, even if a machine is apparently running well with the usual gauze brushes, the substitution of the later type will bring down the heating at the contact surfaces by several degrees. Owing to the soft and springy nature of the crimpled wire interior, friction is reduced to a minimum: while the casing is constructed to obtain any required degree of firmness without the danger of spreading. Highest conductivity is also attained, as the weight of copper in a brush of this make is at least 25 per cent. more than in a gauze brush of the same dimensions.

Staff Dinner.—The fittings warehouse section of the staff of the Edison & Swan United Electric Light Company, Limited, held the first of a series of social meetings for the winter season on Monday, October 30th, at the Champion Hotel, Aldersgate Street, E.C., where the party sat down to dinner, which was followed by a musical programme. Mr. A. V. Kyrke occupied the chair. Other departments were represented, and a very enjoyable evening was spent.

Trade Announcements.—The Phodyne Electrical Company, Limited, of 66, Victoria Street, S.W., have acquired the electrical contracting business hitherto carried on at that address by Messrs. A. A. C. Swinton & Co., and have taken over the latter firm's staff and offices. Mr. J. C. M. Stanton, M.I.E.E., who of late years has managed Messrs. Swinton & Co.'s contracting business, is managing director of the Phodyne Electrical Co. The firm of A. A. C. Swinton & Co., whose business the Phodyne Co. acquire, was formed some 11 years ago by Mr. A. A. Campbell Swinton. During this period they have carried out numerous and large electric installations, notably in connection with the electric lighting of country houses, among which may be mentioned the country seats of the Marquis of Tweeddale, the Earl of Durham, Lord Rendel, Lord Hamilton of Dalzell, The Mackintosh of Mackintosh, Sir John Stirling Maxwell, M.P., and have in hand at the present time, among others, Bamburgh Castle for Lord Armstrong, and Haggerston Castle. The Phodyne Co. will continue to make a speciality of this class of work, in addition to developing its business in other directions. Mr. A. A. Campbell Swinton has removed to new offices in the same building, 66, Victoria Street, Westminster, where he will continue his consulting practice.

The British Thomson-Houston Company wish us to intimate to their customers that the prices of their electrical apparatus and supplies are being revised. New lists are in course of preparation, and will be ready shortly.

Messrs. Allan & Adamson, Limited, announce their change of address to Clun House, Surrey Street, Strand, W.C. In order to meet the increasing demand for the Allan accumulator it has been found necessary to erect improved works, where the manufacture of these storage batteries can be conducted on a large scale. These works are at Ashstead, Surrey, but communications should be addressed to the London office.

Warren v. St. James's and Pall Mall Electric Light Company.—The High Bailiff of Westminster and a special jury sat on October 28th at the Guildhall, Westminster, to assess the claim made by Mr. Edward Warren against the St. James's and Pall Mall Electric Light Company, in respect of a 16 years' unexpired lease of his premises, known as 40, Marshall Street, Golden Square. Mr. Robson, Q.C., M.P., and Mr. Lawless appeared on behalf of the claimant, and Mr. Balfour Browne, Q.C., and Mr. Davis represented the company. The premises in respect of which the claim arose, have already been taken by the company under their Act of this year for the purpose of erecting on the site thereof a new generating station. On behalf of the claimant expert evidence was given, and the jury, after hearing counsel, assessed the value at £630.

Wire Bound Hose.—Messrs. W. H. Willcox & Co., Limited, have recently introduced with great success a special make of their patent wire bound hose, which they term the "special traction engine quality." They claim to have paid particular attention to the study of the requirements of this class of engine, and to have brought out a specially constructed quality which they are confident meets in every way the demands made upon the water-lifter hoses. A large number of the principal traction engine builders and owners have adopted the use of this hose with general satisfaction. In the construction of the hose there is no rubber to perish in its composition, and it is stated to outlast several ordinary rubber hoses for this reason. It is made with wire on the inside, and also bound externally in such a manner as to effectually prevent kinking. It is prepared in a special way, and is very strong and durable.

ELECTRIC LIGHTING NOTES.

Bala.—A public meeting was held last week to consider the question of electricity supply for the town. It was decided to obtain expert advice on the subject, and to canvass probable consumers. Out of nine speakers, six bore the name of Jones!

Barking.—An inquiry was held last week by Colonel A. C. Smith, R.E., inspector of the Local Government Board, with reference to an application to borrow £13,280 for purposes of electric lighting. It was stated that sanction for £15,000 was obtained last year for the carrying out of an electric light scheme, which provided sufficient plant to supply electricity to the whole of the street lamps, together with 2,000 8-C.P. lamps for private lighting. The whole of the works provided for in the original scheme had been carried out. At the present time there were applications for 4,500 more private lamps, in addition to an application from Messrs. Lawes, at Creeksmouth, who had guaranteed the Council the sum of £250 for seven years. Messrs. De Pass had also guaranteed £200 for seven years, whilst application for the light had been made by the East London Waterworks Company, Messrs. Warne & Co., and others. The number of lamps actually connected was 650 C.P. in excess of that contemplated when the original loan was sanctioned. The Council had decided to receive no additional applications until the plant was extended. A further sum of £1,800 was included in the application, £1,000 of this being for the extension of the electric light works. This brought the total amount asked for up to £15,080. There was no opposition.

Bath.—At a meeting of the Council last week, the final bill by Mr. R. Hammond for professional services as expert adviser, amounting to £280, was received and sent to the auditor. Messrs. Callender wrote pointing out that they had never been allowed to complete their original contract for laying mains, and that they could compel the Corporation to receive 28,000 yards of high tension cable; they were willing that some arrangement should be come to as to the proposed extensions. The letter was sent to the Works Committee.

Bedford.—The Town Council having applied to the Local Government Board for sanction to borrow £41,000 for purposes of electric lighting, Colonel A. J. Hepper on Thursday last week held an inquiry. The town clerk said that the amounts already sanctioned for electric lighting purposes were £63,450. The engineer said that the output had been rapidly increasing, the light had become more popular, and there was a greater demand for it. He estimated the output for the year at 750,000 units. The present application embraced all the streets not previously included. The buildings were for new boilers, condensers, and four new sub-stations. The price of supply was 5d. per unit with 10 per cent. discount. The inspector paid a visit to the electricity works.

Boston.—A special meeting of the Town Council was held last week to consider a resolution of the Finance Committee, recommending the Council to offer £60,000 to the Boston Gas Company for their undertaking. The Council rejected the recommendation, and, instead, decided to apply for a provisional order under the Electric Lighting Act, enabling the Council to supply the town with electric light.

Brighouse.—The Town Council has decided that the price of electricity for lighting purposes be increased from 5d. to 6d. per Board of Trade unit, a previous resolution of the Council that the price be 7d. being rescinded. This alteration in price, the electrical engineer reported, would reduce the deficiency of £205 8s. 2d. in this department for the past year to one of £58 6s. 8d. in the current year. The engineer presented a report recommending the laying down of a new electrical generating plant in order that the department might be made to pay.

Bristol.—The Town Council is about to erect nearly 400 additional arc lamps, to take the place of existing gas lamps.

Ceylon.—The electric lighting of Kandy is being carried out under the management of Mr. J. E. Addyman, the resident electrical engineer of the Colombo Gas and Water Company. A large part of the mains has already been laid on the system of the British Insulated Wire Company, Limited. The generating station is nearly complete, and supply will be commenced in a few months.

Cleethorpes.—Mr. C. S. V. Brown has presented his report on the proposed electric lighting of the town to the District Council, which has decided to obtain a provisional order as soon as possible.

Croydon.—The Board of Guardians has approved the report of a Special Committee in favour of fitting the Workhouse, Infirmary, and offices with electric lighting at an estimated cost of £2,500.

Dartford.—The District Council, after careful consideration of Mr. Hawtayne's report, has decided to adopt his scheme for the electric lighting of the town, and has resolved to apply for permission to raise a loan for the amount estimated by Mr. Hawtayne.

Dolgelly.—The District Council has appointed a committee to consider the question of electric lighting for the town.

Dudley.—Mr. Herbert H. Law, C.E., has held a public inquiry at Dudley relative to the application of the Town Council for permission to borrow, amongst other items, £33,000 for electric lighting purposes. The town clerk stated that the population of the town was 50,000, its ratable value was £113,180, and the outstanding loans amounted to £63,037. In 1897 the Town Council obtained their electric lighting order, and in 1898 the British Electric Traction Company took over the local steam tramways, proposing to electrically equip them. The Town Council opposed that part of the electrical proposals which had reference to the borough, and eventually an arrangement was come to under which the traction company agreed to take what power they required within the borough from the Town Council. It was added that this was the second loan under this head which had been applied for, a generating station sufficient to work the tramways being now in operation. Mr. R. Wilson, electrical engineer, said it was proposed to erect arc lamps on some of the tramway poles. Numerous applications, including two from large works, had already been received for the light. The present generating station consisted of two engines and boilers, with two dynamos, in a corrugated iron shed. The permanent building would be erected round and over the present building. In the new building would be placed two more boilers, fitted with mechanical stokers, and two more dynamos. One of the engines would be 100 H.P., and the other three 200 H.P., the dynamos corresponding. The Commissioner said he believed the loan would be granted for 25 years. The Commissioner, at the conclusion of the inquiry, visited the site of the electrical works.

Exeter.—The Electric Lighting Committee reports to the City Council that upon the accounts of the year ending December 31st last there was a surplus profit of £548 8s. 8d., after payment of all interest and sinking fund.

Glasgow.—Last week the Electricity Committee of the Corporation resolved to recommend that churches be offered supplies of electricity for lighting purposes at 3d. per unit, or half the ordinary rate.

Grays.—Colonel Durnford, R.E., recently held an inquiry on behalf of the Local Government Board into the application of the Urban Council for sanction to borrow £13,000 for electric lighting purposes. Mr. A. H. Preece, electrical engineer, said an arrangement had been entered into for the purchase of land for a lighting station. There were at present 186 public lamps, which would have to be lighted by electricity. These now cost £700 a year, and this amount would have to be credited to the new scheme. The income from private lamps should amount to at least £1,000 per year, giving a total income of £1,700 per annum. Allowing for the cost for interest and sinking fund on the loan, a sum of £1,600, they would have a credit balance of about £100 a year. The repayment of the loan would come to about £700, and the interest on sinking fund and working expenses would be about £900. The Council had received a requisition to adopt electricity by a large number of the ratepayers. There was no opposition.

Henley.—The Town Council has resolved to obtain a provisional order for electric lighting, and has under consideration a report and estimate by Messrs. Shone & Ault on the subject.

Heston and Isleworth.—In the *London Gazette* last Friday there appeared the usual notice of intention to apply to the Board of Trade for a provisional order for the District Council.

Hythe.—The Town Council has resolved to obtain a provisional order for electric lighting, with a view to forestalling the Folkestone Electricity Supply Company.

Ilford.—The Local Government Board has sanctioned loans of £4,400 for the purchase of land for the electric light and tramway stations.

Italy.—The Società Tramvie e Ferrovie Elettricite Varesine has received official permission to put down plant to utilise the water-power of the Giona and Cannera (Como) streams.

King's Norton.—The Urban District Council is considering the question of an electricity supply, for which the late Rural District Council obtained an order in 1898. The duration of the order will shortly expire.

Kingston-on-Thames.—The Local Government Board has sanctioned the raising of a loan of £15,000 by the Town Council on the understanding that no part of the money borrowed would be expended in payments to salaried officers of the Council, or in buying incandescent lamps. The Council has raised the salary of the electrical engineer, Mr. Edgcombe, from £300 to £350 per annum.

Leicester.—The Town Council has approved of the recommendation of the Electric Lighting Committee to borrow £100,000 for necessary extensions. At a recent meeting Alderman Lennard pointed out the steady increase in the demand for electric light in Leicester. The revenue from the department had increased from £963 in 1895 to £5,040 in 1899. It was now proposed to put in additional alternators and engines to increase the capacity from 1,600 K.W. to 4,000 K.W., and it was estimated that this would meet the demand for the next five or six years. The price at present charged for the light was 4d. per Board of Trade unit, and 2d. per unit for power.

Liversedge.—On Monday the District Council decided to apply to the Board of Trade for a provisional order, authorising the Council to supply electricity for public and private purposes within their district.

London, E.C.—The Limehouse District Board has decided to apply for a provisional order to light the district by electricity. An influential deputation from the East End districts of Mile End, Limehouse, and St. George's, waited upon Sir Courtenay Boyle, in the unavoidable absence of Mr. Ritchie, at the Board of Trade this week. The deputation asked the Board of

Trade either to allow them to jointly commence their own electric lighting scheme or to revoke the order which had been granted to the County of London and Brush Provincial Company over two years ago, and which work had not been commenced. Sir C. Boyle promised to go fully into the matter with Mr. Ritchie.

Malton.—A special meeting of the District Council was held last week to receive Mr. C. W. Fairley, representing the Northern Counties Electrical Supply Company, who explained the company's scheme for establishing electricity works in Malton. The subject is to be further considered.

Mexico.—A Berlin correspondent of the *Financial Times* states that the Mexican Electric Works, Limited, in which the Dresden Bank and the Swiss Company for Electrical Industry of Basle are interested, and which partially commenced work in Mexico at the beginning of 1898, was enabled to set the works in full operation in October of the same year. The development of the company during the first working year has not quite equalled the original expectations. Nevertheless the available surplus will allow of the payment for the first financial year ended on October 1st of a dividend of 6 per cent., and in order to meet this the Siemens & Halske Company, which guaranteed a 6 per cent. dividend for the first three years, will only be required to provide a small amount of money to make up the deficiency. It is expected that improved results will be obtained next year, especially as the number of consumers and lamp connections is increasing.

Mexborough.—Colonel A. J. Hepper, D.S.O., R.E., inspector of the Local Government Board, last week held an inquiry into the application of the District Council for sanction to borrow £1,428 for the purchasing of land for the erection of an electric lighting station and other purposes.

Newark.—At a special meeting last week the Town Council authorised application being made for a provisional order for electric lighting purposes.

North Riding.—The County Council has resolved that application be made to the Local Government Board for leave to borrow a sum of £4,500 for the purpose of carrying out a scheme of electric lighting at the North Riding Pauper Lunatic Asylum, such sum to be repaid by 10 equal annual instalments of principal and interest combined.

Northampton.—The electric light has been installed in St. Katherine's Church, by Mr. Geo. Basham for the National Electric Wiring Company, Limited. The company have also secured the contract for Messrs. Crick & Co.'s boot factory. The N.E.W. Co. have connected over 70 consumers here in less than seven months.

Pontefract.—At a meeting of the Board of Guardians on October 28th the report of Mr. G. R. Peers, electrical engineer, was read with regard to the lighting of Pontefract Workhouse by means of electricity. He estimated for 470 lamps, mostly of 16-C.P., at a total cost of £1,900, and at a working expense per annum of £208. The Board decided to obtain tenders for the carrying out of the work.

Prestwich.—The Urban Council gives the usual notice in the *London Gazette* of its intention to apply to the Board of Trade during the 1900 session for an electric lighting provisional order.

Rhyl.—The Council is considering the question of providing plant for supplying the whole of the town with electric light.

St. Pancras.—The Vestry on Wednesday resolved to purchase for £7,500 the freehold interest of property adjoining the King's Road generating station for the extension of the works.

Salford.—At the meeting of the Council on Monday, the resolution of the Tramways Committee, recommending that the Council make application to the Board of Trade for sanction to borrow the sum of £53,450, to cover the cost of the purchase of 100 electric tramcars, was considered. There was also on the agenda a resolution of the Electric Light Committee accepting the tender of Messrs. Galloways, Limited, for boilers and fittings, required for the Strawberry Road station, for the sum of £15,200, and another recommending the Council to apply to the Local Government Board for sanction to borrow the sum of £72,000 for the construction of eight sets of steam dynamos, required for the new low pressure generating station in Strawberry Road. In addition there were resolutions to borrow £750 for offices and battery sub-stations, and £879 for the erection of a retaining wall. The Council approved of the recommendations.

Saltburn.—The supply of electricity has now been begun; there are about 1,200 lamps connected, and a large number about to be wired. The sea front is also to be lighted with arc lamps.

Shipley.—A report on the question of electricity supply in the district has been presented to the District Council by Mr. R. C. Quin, outlining a system of supply capable of dealing with tramways, street lighting, pumping and sewage. Mr. Quin strongly recommended that wherever distributing mains were laid the streets should be electrically lighted. He thought it would be well to fix the cost of energy for street lighting at 2d. per unit. This would leave a slight margin of profit to the electricity department, and would be equal, light for light, with gas (Welsbach incandescent) at approximately 2s. per 1,000 cubic feet. The charge to the public he recommended should be 7d. for the first hour's use, on a six months' basis, and 2d. per unit for any further units consumed in the same period. Mr. Quin's estimate of costs amounted to £14,476, made up of the following items:—Generating station, £1,700; mains, £9,000; street lighting, £264; 100 services to consumers at £10 each, £1,000; contingencies, 10 per cent., £1,196; engineering and other expenses, 10 per cent., £1,316.

Southwick.—The Southwick District Council has appointed three members to meet three members from the Shoreham Council and three members of the Portslade Council, in order to discuss the advisability of obtaining powers for the electric lighting of the districts within the jurisdiction of these authorities.

Stoke-on-Trent.—The Board of Guardians last week adopted the report of a committee to the effect that Mr. G. R. Peers's scheme for the electric lighting of the workhouse, cottage homes, &c., at a cost of £4,250, be approved, as well as his estimate for subsequent extensions, costing £2,300. The Board will apply to the Local Government Board for sanction to the necessary loans, to be repaid within 30 years.

Swinton and Pendlebury.—In the report which Mr. C. Hopkinson has presented to the District Council on the subject of its electric lighting scheme, he estimates that the revenue from lighting and traction at the end of the second year would, within a few pounds, balance the expenditure on interest and sinking fund and generating costs, including repairs and maintenance. Mr. Hopkinson believes the Council would find either Manchester or Salford willing to supply the occupiers of property in Swinton on terms which they could not themselves hope to attain to, unless by a large development of the traction load.

Thirsk.—The Thirsk Rural District Council has agreed to the Northern Counties Electricity Supply Company's electric lighting scheme, contingent on the approval of the Thirsk, Sowerby, and Carlton Miniott Parish Councils.

Walker.—At a meeting of the District Council on Tuesday last, it was stated that the money required for buildings, plant, engineers' fees, destructor, purchase of land, Parliamentary and legal expenses, would amount to £29,943, and it was recommended that the Council apply to the Local Government Board for sanction to borrow this money for 30 years. It was also stated that the Newcastle Electric Supply Company had written offering to supply electrical energy in Walker district on advantageous terms, and a committee was appointed to meet the company and report. The report was adopted.

Wallasley.—The Local Government Board has sanctioned the District Council's application for leave to borrow £10,000 for electric lighting purposes, the loan to be repaid in 24 years.

Windsor.—In consequence of the increasing demands made upon the electricity works, and the delay in delivery of the new 400-H.P. engine, a large portable plant of 70 B.H.P. has been temporarily installed at the Peascod Street station. The Lighting Company has just had a 220-H.P. engine and dynamo placed in position, as well as a new boiler.

Wolverhampton.—At a meeting of the Town Council on Monday last the Lighting Committee presented a report with regard to a proposed extension of their plant. They stated that, having regard to the extreme difficulty in obtaining electrical machinery, except upon very long notice, owing to the fact that the leading manufacturers are exceedingly busy, they desired the authority of the Council to obtain and accept tenders immediately for two 700-H.P. steam dynamos, at an estimated cost of £11,000. The constantly increasing demand for electrical energy, for lighting and power purposes, renders it extremely probable that the whole of the plant in respect of which the expenditure of £29,000 was sanctioned by the Council in October last, will be taken up in the course of the next few months. The committee accordingly recommended that the Finance Committee be authorised to apply to the Local Government Board for their sanction to a loan for the purchase of the plant, to borrow the requisite moneys, and, if necessary, to raise Wolverhampton Corporation stock for such purpose.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Accrington.—At a recent Town Council committee meeting a deputation from the Tramway Company attended, and Mr. Garcke, of the British Electric Traction Company, made a long statement in general terms of the policy of that company in buying up such concerns as the Accrington Tramway Company. The chairman requested him to put any proposals in writing, and submit them for the consideration of the committee.

Belfast.—The tenders for rails, &c., for tramways extensions have been referred to a sub-committee of the Council Joint Improvement and Electric Committee.

Birmingham.—The Birmingham and District Tramway Company having intimated their intention of substituting electric traction for the present system of steam between Birmingham, Smethwick, Tividale, and Dudley, the Rowley Regis District Council have decided to waive their statutory rights of purchase for two years.

Blackheath and Woolwich.—We are glad to note that the local opposition to the London County Council scheme for the establishment of electrical tramways between Blackheath and Woolwich is not meeting with much support. Obviously some means of communication are required, the towns are only about a mile and a half apart, and are already connected by rail, but it is sufficient to state that the railway is in the hands of the notorious

South-Eastern Company to understand the position of affairs; but even that company, as regards service between Blackheath and Woolwich, can surely claim a record for this part of their system, since three trains only are run east between the hours of 9.2 a.m. and 12.40 p.m., and no attempt appears to be made to run on time. To cap all, one of these trains is taken off on Saturdays. Surely this is a case where electrical tramways are demanded, the traffic should be great, the public will be greatly convenienced, and as regards profits, these tramways will be run in competition with a railway company who charge 10d. for a first-class return, where the distance, going and coming, is not over three miles.

Blackpool.—The Town Council has resolved to apply for sanction to a loan of £42,515 for extensions of the Corporation electricity works in connection with the supply of electricity for tramway purposes.

Bolton.—The new cars for the Bolton and district new tramway system were subjected to tests on Monday and Tuesday, and as these were perfectly satisfactory, the lines to Tonge Moor will be opened for traffic immediately the Board of Trade certificate has been received.

The Council has appointed Mr. H. England to the position of general traffic manager for the electric tramways.

Bootle.—Last week the Council held the necessary statutory meeting to pass a recommendation submitted by the General Purposes Committee, to the effect that an application be made to the Board of Trade authorising the construction of the following tramways to be worked by electric traction in the district:—

Tramway No. 1: An additional tramway in Stanley Road, commencing at Marsh Lane and terminating at the Litherland boundary. Tramway No. 2: A double tramway in Knowsley Road, from Stanley Road to the western extremity of the tramway sanctioned by the Bootle-cum-Linacre Tramways Order of 1884. Tramway No. 3: A double tramway to connect the existing tramways in Rimrose Road with the proposed new tramways in Knowsley Road and with the Seaforth tramway. Tramway No. 4: A double tramway commencing at the terminus of the existing tramway in Strand Road, at the junction with Derby Road, passing along Strand Road westward, Regent Road northward to Lyster Road, and Lyster Road, terminating by a junction with the existing tramway in Rimrose Road.

Bowness.—On October 26th, on the invitation of Mr. Frederick Fowkes, managing director of the Windermere and District Electricity Supply Company, several members and officials of the Ambleside and Bowness District Councils and of the County Council left Windermere on a two-days' visit to Dudley and Kidderminster, for the purpose of inspecting the electric tramways.

Burnley.—The Town Council last week passed recommendations by the Tramways Committee, whose Sub-Committee had submitted plans prepared by the borough surveyor for the reconstruction of the tramway between Padiham and Nelson as a double line (except where impracticable owing to the narrowness of the roadway) on a gauge of 4 feet, and also plans of proposed tramways along the following routes, namely: (1) Yorkshire Street and Brunshaw Road; (2) Todmorden Road from Yorkshire Street to Causeway End; (3) Manchester Road to a point about 100 yards above Roberts Row; and (4) Accrington Road from Mitre Bridge to the junction of Rosegrove Lane, thence over the railway bridge to a point on the north side of the railway. Alderman Armistead gave a lengthy report with respect to the proposed new tramways, and said that after serious consideration, the Committee had decided to proceed by Bill instead of provisional order, and the public would benefit very considerably thereby. He referred to the decision of the Committee to have a 4-foot gauge instead of a 3 feet 6 inches gauge, remarking that Lord Jersey, at a light railway inquiry at Colne, recommended that the larger gauge would be better. The new tramway would be double nearly all the way from Padiham to Nelson. The lines from Padiham to Nelson would involve an expenditure of £67,000, the accessories, such as cars, of which there would be 25, would cost £24,000, and the line extensions up Manchester Road, &c., would mean an outlay of £41,800. It would be optional for the authorities of Padiham, Brierfield, and Nelson to reconstruct their own lengths, or they could arrange for the Corporation to do it. Of course, these figures did not include the purchase of the existing lines, which would be settled by arbitration.

Dartford.—The Urban District Council has resolved to interview Mr. Walter Beer, of Victoria Street, Westminster, on the question of constructing a tramway from the terminus of the Woolwich and South-Eastern Tramways at Plumstead through Erith to Dartford.

Derby—Ashbourne.—On 24th ult. Sir Courtenay Boyle heard the promoters and opponents to the light electric railway order for a line 11 miles in length between Derby and Ashbourne, and four smaller railways necessary to complete such connection. When this order was last before the Board of Trade Sir Courtenay Boyle pointed out that there were several gradients and curves and other points gravely affecting the safety of the public which the Board of Trade officers considered should go back to the Light Railway Commissioners for further consideration, and the matters now to be settled were the engineering points then raised. The objectors were the Derby Corporation, represented by Mr. Etherington Smith and Mr. Gadsby, town clerk, and the Derbyshire County Council, for whom Mr. Hughes Hallett, clerk of the peace, appeared. The promoters were represented by Mr. C. R. Eddowes, solicitor, and Messrs. Cooper & Sons, Parliamentary agents. The first objection raised by the Board of Trade was to the promoters having power to reduce the radius of a curve to 1 chain at the Ashbourne end of the line on the ground of its being a danger to the public. Mr. Eddowes, solicitor for the promoters, said the pace would be slow on the incline going into Ashbourne.—Sir C. Boyle: But the clause, as it stood, would allow them to alter any of the curves on the light railway to 1 chain.—Sir Francis Marindin: One chain is very objectionable.—Mr. R. E. Crompton: We only want it for the line going into the private grounds off the street of Ashbourne, and it will be at a walking pace.—Sir C. Boyle: I have no objection to its being altered to 1½ chains, and that must be done.—Mr. Etherington Smith, for the Derby Corporation, who opposed, wanted to know what facilities the promoters would give at the Uttoxeter Road to the Corporation of Derby to prevent interference with their electric tramways. Among other points dealt with was the objection of the inspecting officers of the Board of Trade to the mode of construction, which they considered unsatisfactory and dangerous. To meet this the promoters offered not to lay guard rails, and to make the roadway level with the rails, in the country by ballast, in the town by means of tarred macadam, the wheels cutting their own groove. Mr. Etherington Smith said the Corporation considered this method was dangerous and unsatisfactory.—Sir Courtenay Boyle said the inspecting officers adhered to their objections, and he could not pass the clause on the present occasion. He would not reject it, however, because he understood the Light Railway Commissioners wished to confer with the Board of Trade upon the subject. He therefore postponed the consideration of the clause.

Dublin.—On 24th ult. electric cars commenced running on the Palmerston Park route, on which they will run right through to Dollymount. The Drumcondra line is also electrically equipped, and will be in full working order in the course of a few weeks. This section will be joined to the Haroldscross system, and cars will then run between Drumcondra and Terenure, *vid* Nelson's Pillar and South Great George's Street, while the Glasnevin cars will run through Dorset Street and Capel Street to College Green. The only horse lines now running are to and from Drumcondra, Glasnevin, Hatch Street, and between Haddington Road and Sandymount Tower, but all these lines will shortly be run electrically. As soon as the Hatch Street line is completed, the electric cars now running from Parkgate Street to Westland Row will go on to Hatch Street. A new line is in course of formation in Lower and Upper Leeson Street, and is already far advanced.

Dundee.—The proposal to extend the electric tramway line between Dundee and Monifieth, to accomplish which steps have been taken, and further east to Carnoustie, is also engaging attention. In August Mr. Addyman, solicitor, Leeds, the agent for the promoters of the line, was in the district, and the Carnoustie Commissioners appointed a committee to interview him on the point of having the tramway extended to the burgh. Mr. Addyman met the committee, and at his request the views of the Commisioners were submitted in writing. During the intervening period the matter has been receiving the attention both of the promoters and the Carnoustie Commissioners, and in the beginning of October Mr. Addyman again visited the district and indicated to the committee that, subject to a report by the engineer, he was favourable to the tramway being extended to the eastern boundary of Carnoustie. The promoters have now made a communication to the Carnoustie Commissioners, saying that if the district provides the promoters with a roadway which will enable an economical mode of construction to be adopted, the promoters are willing to accede to the Commissioners' request. Mr. Hopkins and Mr. Richie, engineers on behalf of the promoters, visited the district last week, examined the road, and had interviews with committees from both Broughty Ferry and Carnoustie Commissions.

Eccles.—The Town Council on Monday passed a resolution in favour of the promotion by the United Kingdom Tramway Syndicate of a provisional order for the construction of tramways to connect the borough with Urmston, on the one hand, and Whitefield on the other. The line will pass through several urban districts, and each local authority reserves the option of supplying the electric current for traction purposes within its area, at a price to be agreed upon, and also the power to elect, within a reasonable period after the confirmation of the provisional order, to undertake the construction of the tramways, and also, at their option, to provide electrical equipment. The lines are all to be worked on the overhead trolley system, and the cars are "double-deckers." There are at present 31 miles of track, covering some 28 miles of streets.

Exeter.—The City Council is carrying on negotiations for the acquisition, from the Tramways Purchase Syndicate, of the horse tramways now in operation in that city, and it is proposed, when they are under municipal control, to use electric traction for the system, which will be about doubled in length when the outlying suburbs are annexed by the city authorities. The Council has, under the tramway order, compulsory purchasing powers in 1902, but in view of the immediate extension of the city boundaries, it is proposed to acquire the undertaking before that time; and at a meeting of the Council on Wednesday (25th) it was decided to offer the syndicate a 10 per cent. premium on a valuation of the undertaking, to be carried out on the Board of Trade basis. The syndicate's present valuation is £9,300, and they asked for a 40 per cent. premium.

Halifax.—The Elland District Council will not accept the proposals of the Halifax Corporation to extend their system of electric tramways to Elland. The barrier to agreement is as to who shall supply the current. It is probable that Elland will oppose the application of the Halifax Corporation to construct lines through a portion of their district to Brighouse.

Lancaster and Morecambe.—Last week at the Lancaster Town Council meeting the Mayor reported upon the negotiations for the purchase of the tramways from Lancaster to Morecambe, and the proposals for a system of electric tramways by the overhead trolley system.

Leeds.—The Tramways Committee has decided to accept the tenders of Messrs. Dick, Kerr & Co., for 50 fully equipped electric cars at a cost of £550 per car, making a total of £27,500. The order has been placed in anticipation of the requirements of next summer and autumn, when it is hoped that the Dewsbury Road, Hunslet, Beeston Hill, and Elland Road sections will be ready for working. The first delivery is to take place in the latter part of June, and the contract is to be completed by the end of August. The electric cars for the Ohapeltown and Headingley route are, of course, in hand, and it is expected that that section may be at work in less than a fortnight's time.

Limerick.—The Corporation last week passed a resolution in favour of the electric tram scheme. Before and after the meeting the opposing carmen and others of the great Irish public made themselves a little troublesome both outside and inside the building, but a strong force of police succeeded in preventing a too hostile demonstration. The length of the proposed lines is six miles, and it is expected that the construction work may be commenced by January next.

Liverpool.—The Council has resolved to apply for a provisional order for the construction of a tramway (500 yards) which the Bootle Corporation has requested, in order to connect County Road and Bedford Road with the docks. The Council also approved various recommendations for road widening for the electric tramways in the city.

Margate.—A daily paper says that the construction of the electric railway, which was stopped at the commencement of the season, has been resumed, the course taken being along the Marine Terrace to the westward.

Merthyr.—A commencement is about to be made with the construction of the light electric railway here.

Middlesex.—Mr. Galsby, electrical engineer, has prepared a lengthy report upon the proposed light railways in Middlesex for the County Council. The amount involved in their construction is about £240,000. The Council is going on with the scheme for the provision of light railways in the county.

Motor Dust Carts.—The St. George's (Hanover Square) Vestry has decided to purchase or hire, as an experiment, at a cost not exceeding £500, a motor dust van.

Portsmouth.—The Tramways Committee are completing arrangements for taking over the local tramways from the company at the close of the present year. At an employés' dinner just held, Mr. A. W. White, J.P., the company's manager, was the recipient of a massive silver salad bowl and service. The employés on the Gosport lines presented Mr. White with a silver inkstand. At a meeting of the Tramways Committee, the superintendent (Mr. Roller) reported that he had completed the surveys for the five new sections proposed by the committee. It was decided to have double lines wherever practicable. The arrangements for the introduction of electric traction are now under consideration.

Preston.—The electric tramways, referred to last week, will be 4 feet gauge and equipped on the overhead trolley system.

Salford.—The Town Council on Monday considered a series of resolutions of the Tramways Committee. One resolution was to accept the tender of the Westinghouse Electric Company for the supply of 100 tramcars at the rate of £534 10s. per car, subject to the bodies being manufactured by Messrs. Milnes & Co., of Birkenhead, and the trucks being those known as the Brill trucks. A further resolution was to make application to the Board of Trade for its sanction to the borrowing of £53,450 to cover the cost of the cars. The committee recommended the appointment, as tramway engineer, of Mr. E. Hatton, Birkenhead, at a salary of £240 a year. The several resolutions and recommendations were confirmed. The cars, it was explained, are to be "double-deckers," designed to carry 45 passengers, or more in emergency.

Sheffield.—On 26th ult. a trolley wheel ran off the overhead conductor, the arm struck against a cross standard and was bent. It afterwards became entangled in the guard wires. There was consequently a stoppage of the traffic for a short time.

South Staffordshire.—At a meeting of the Urban District Council of Bilston last week, a communication was received from the Light Railway Commissioners relative to the construction of the South Staffordshire Light Railways. In this it was stated that the Commissioners had settled the order authorising the railway to be made, and that it had been submitted to the Board of Trade for confirmation. It was also stated that the period during which the local authorities of Bilston and Willenhall might take over the portion of the railway in their districts, had been increased from 25 to 28 years.

Stalybridge.—A joint conference was held last week of representatives of the Corporations of Stalybridge, Mossley, and Hyde, and the Urban District Council of Dukinfield, to consider the suggested scheme for providing electric traction and lighting for the four towns named. The suggestion was made some time ago by the Mayor of Stalybridge, and the Corporation decided to invite representatives of the local authorities to discuss the question, and, if possible, to formulate a scheme. After full discussion, a resolution was passed unanimously in favour of the undertaking, and the representatives promised to bring the matter before their respective Councils, and to recommend that each should pay its share *pro rata* towards the expenses of engaging an engineer and defraying the formation expenses.

Tynemouth.—At last week's Council meeting Alderman Armstrong stated that arrangements for the supply of electricity for illuminating and traction purposes were proceeding satisfactorily, and it was anticipated that by Easter they would be able to supply the tramway company with power to work the trams. It would be necessary to appoint an electrical engineer to take charge of the works. The Committee has decided to offer the Market to the tramway company as a tram shed for £4,000.

TELEGRAPH AND TELEPHONE NOTES.

Cable Interruption.—The Eastern Telegraph Company announced on Tuesday that the cable between Delagoa Bay and Mozambique on the east coast of Africa became interrupted on Monday. Telegraphic communication with South Africa is maintained by the cables on the west coast of Africa, which are working well. The cable ship *Great Northern* is due at Delagoa Bay to-day, and the company is endeavouring to send her instructions to stop at the position of the break in the cable.

Glasgow Telephones.—We print the following abstracted remarks from the *North British Weekly Mail* as reflecting the present feeling and situation regarding the municipal telephone question at Glasgow:—"After their long and successful fight for the municipalisation of the telephone, the Glasgow Corporation had the right to expect that on the passing of the Telephone Act of last session they would receive a telephone license from the Postmaster-General without the slightest delay. It was certainly not the intention of Mr. Hanbury, who acted for the Government in carrying the measure through the House of Commons, that there should be any delay in the granting of licenses to municipalities. And it was not the intention of Parliament. The desire was to set up public competition with the National Telephone Company as quickly as possible. But the Post Office is slow to move in this important matter. Immediately after the passing of the Act, in August last, the Corporation renewed their repeated application for a telephone license. It has taken more than two months to obtain a satisfactory answer. The Corporation continued to press upon the Postmaster-General, by means of frequent letters, the desirability of at once letting them have the draft license: but not till last week did he send them the printed form of license which he proposes to grant. Such delay is not creditable to the Post Office. It gives ground for the suspicion that the officials of that Department have not yet quite freed themselves from the influence of the company. While it has taken them so much time to draft the form of license for municipalities, they have found time to prepare and issue an order as to telephonic intercommunication which is very much in the company's interest. No time has been lost by the Telephone Committee of the Glasgow Corporation in considering the terms of the draft license which they have at length received. They have had the choice of two periods of license—one of them extending to December 31st, 1913, and the other extending to December 31st, 1925. The longer period would doubtless have been considered the preferable one, as giving the Corporation more time to make good their expenditure, if the conditions had been the same as for the shorter period. But if the Corporation had asked for a license up till the end of 1925, the Postmaster-General would almost certainly have exercised his power to extend the company's license in Glasgow to the same date. It is most undesirable that the license of the company should be extended a day beyond its original term. The Telephone Committee of the Glasgow Corporation have therefore recommended that the Corporation's telephone license should be for the shorter period—that is, up to December 31st, 1913. At the same time the Committee have applied to the various suburban burghs within the Glasgow Telephone Exchange area for their consent to the Corporation's license for that area. It is of the utmost importance that competition should be established as soon as possible. It is not the Corporation who will be responsible for any delay that there may be in establishing the desired municipal competition. Only the slowness of the Post Office stands in the way. And the Corporation will have to keep on hammering at the Post Office until it does all that Parliament has ordered in connection with the granting of a license."

The G.P.O. and Battersea Vestry.—The Battersea Vestry last week declined to withdraw the condition, attached to consents given to the laying of Post Office pipes, that the pipes are only to be used for telegraph wires. This decision was arrived at notwithstanding the threat of the Postmaster-General to take proceedings in the matter failing compliance within 15 days from October 9th, and that one consent related to the laying of telephone pipes in connection with the Government telephone system for London.

Local Authorities and the London Telephone Service.—At the meeting of the members of the Holborn Board of Works on Monday, Mr. G. Phillips, J.P. (chairman), in the chair, a letter was received from the Vestry of Kensington, stating that an application had been received from the Postmaster-General for their consent to lay conduits for underground telephone cables in the district. They considered that the same course should be followed by all local authorities in the matter, and they thought it desirable that a conference should be called to discuss the subject.—Mr. Dinham moved that they approve of the proposal of the Kensington Vestry. The continual taking up of the streets by public companies for the laying of pipes, &c., was a very serious matter, both to the residents of the particular locality in which the work was being carried on, and to the

public generally. It would appear that they had no jurisdiction over the companies.—Mr. J. Trenner seconded the proposition. He favoured the convening of the conference in the hope that the collective wisdom of the local authorities would devolve something that would be beneficial to the public.—The proposition was carried unanimously.

At the last meeting of the Clerkenwell Vestry, Mr. T. B. Clay, Metropolitan superintendent of the National Telephone Company, attended this meeting with reference to the refusal of the Vestry to allow the company to lay sections of conduit in certain streets. He stated that having regard to the altered circumstances since the Post Office had obtained the consent of Parliament to set up a competing scheme, the company asked the Vestry to extend the same privilege to them as to the Post Office. Mr. G. Beard, vice-chairman, said that the Vestry refused the application of the company because they did not think the rental offered by them was sufficient. The committee, however, would reconsider the matter, when the Post Office authorities were opening up the roads for the laying down of their system. He moved that the Board adhere to its former resolution, and refuse the application. The proposition was adopted.

Pacific under Survey.—Honolulu papers received at Vancouver on October 10th, contain the news of the arrival there of the survey ship *Egeria* from her trip south to survey the route of the Pacific cable. The *Bulletin* says:—"The British cable survey cruiser *Egeria*, now lying in Naval Row, arrived Sunday evening from a southerly cruise. She will leave at the end of this week for Esquimalt. The line of the proposed British-Canadian-Australian cable has been surveyed, and the *Egeria* has completed her labours in that respect. It is stated aboard the vessel that the deep-sea soundings made between the proposed cable line and these islands are purely for scientific purposes. As the whole of the Pacific Ocean has to be sounded anyhow, no particular significance is attached to the survey between the Hawaiian Islands and the main line. It is not at all improbable, however, that a branch cable extending to Honolulu, and so connecting this point with the American coast and Australia, will be established. The British cable will very likely be the first telegraphic connection between Hawaii and the rest of the world. A Honolulu branch would greatly increase the value of the British cable. The officers aboard the *Egeria* are at present very busily engaged making up their reports. On September 2nd the *Egeria* was in Kealakakua Bay, Hawaii. On her recent southerly cruise the survey ship went about 700 miles toward Fanning's Island, taking soundings every 20 minutes, and on her return soundings each day. The *Egeria* was to have left Honolulu on the morning of September 28th.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Cayenne-Pinheiro	... Oct. 11, 1899 ...	...
Corea-Japan	... Aug. 7, 1899 ...	...
Gibraltar-Tanger	... Oct. 19, 1899 ...	...
Havre-Waterville	... Oct. 25, 1899 ...	...
Jamaica-Colon	... June 30, 1899 ...	...
Latakia-Cyprus	... June 20, 1899 ...	...
Para-Maranham	... Oct. 20, 1899 ...	Oct. 28, 1899 .
Trinidad-Demerara (1871 original)	Oct. 20, 1899 ...	...
Do. do. (1891 duplicate)	Oct. 6, 1899 ...	...
Zanzibar-Mombasa	... Oct. 27, 1899 ...	...
Lourenco Marques-Mozambique	... Oct. 31, 1899 ...	...
Landlines.		
Colombian Government lines to Bogota	... Oct. 31, 1899 ...	...
Communication with Mafeking	... Oct. 13, 1899 ...	...
Communication with interior of Venezuela	... Sept. 23, 1899 ...	Oct. 27, 1899
Communication with all offices beyond the Orange River	... Oct. 18, 1899 ...	...
Cuban Government lines ...	... Oct. 30, 1899 ...	...
Lines from Haiti to Gonaives, Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	... Aug. 18, 1899 ...	Oct. 25, 1899
Lines from Haiti to Gros Morne and Port de Paix... ...	... Aug. 18, 1899 ...	...
Saigon-Bangkok	... Oct. 24, 1899 ...	Oct. 25, 1899

Wireless Telegraphy.—The United States Navy Department has received information that the battleship *Massachusetts* and the cruiser *New York* have succeeded in keeping up communication with each other at sea, whilst as far apart as 36 miles, by means of wireless telegraphy.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—November 18th. The Corporation wants tenders for cables, wires, street boxes, and connections for electric lighting. See "Official Notices" this week.

Birkenhead.—November 14th. The Corporation wants tenders for 13 single-deck and 31 double-deck electric motor cars, also for boilers, economisers, mechanical stokers, steam dynamos, booster and battery. See "Official Notices" October 20th.

Birkenhead.—November 14th. The Corporation wants tenders for switchboard and instruments for the South End tramway generating station. See "Official Notices" October 27th.

Bradford.—November 9th. The Corporation is inviting tenders for 25 electric tramcar bodies, electrical equipments for same, and trucks and trolleys for ditto. See three of our "Official Notices" October 27th.

Bray.—November 20th. The Council wants tenders for jet condensing plant for electricity works. See "Official Notices" this week.

Croydon.—November 13th. The Guardians want tenders for electric wiring and fitting at the workhouse, infirmary, and union offices. See "Official Notices" October 27th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for the water-tube boiler plant, steam dynamos and switchboard, accumulators for electricity works. From our "Official Notices" this week further particulars may be obtained.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-kw. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" October 27th.

France.—November 14th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of 10,000 metres of pipes 80 mm. diameter for pneumatic despatch tubes. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glasgow.—November 14th. The Corporation wants tenders for two 800-h.p. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" October 13th.

Glasgow.—November 20th. The Electricity Department wants offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" October 13th.

Islington.—November 22nd. The Vestry wants tenders for condensing plant for the electricity works. See "Official Notices" this week.

Leeds.—November 13th. The Corporation wants tenders for wiring, electric lamps, switches and fittings, for the Union Street Baths. See "Official Notices" this week.

Llandudno.—November 6th. The Council wants tenders for three 150-kw. high speed engines and dynamos, also motors and boosters. See "Official Notices" October 20th.

Maidstone.—November 6th. The Corporation wants tenders for steam dynamos, balancers, boosters, boilers, economiser, surface condenser and feed pumps, switchboard, &c., battery, crane, mains, arc lamps and posts, and electricity meters. See "Official Notices," October 20th.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" October 20th.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-h.p. steam dynamos for electric tramway works. See "Official Notices" October 27th.

Newington.—November 13th. The Vestry wants tenders for a 400-kw. steam dynamo and continuous current transformer for the electricity works. See "Official Notices" this week.

Pontefract.—The Guardians are to invite tenders for the lighting of the workhouse premises by electricity.

Poplar.—November 16th. The Board of Works wants tenders for laying mains upon the solid system for three-wire continous current, viz., about 17 miles of five-core network, six miles of six-core feeders, also service cables and accessories. See "Official Notices" this week.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Portsmouth.—November 17th. The Council invites tenders for the supply of 40, 60, or 80 electric tramcars. See our "Official Notices."

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Spain.—November 23rd. Tenders are being invited until November 23rd by the municipal authorities of Chiclana de la Frontera (Cadiz province) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to Le Secretariat del Ayuntamienti de Chiclana de la Frontera (Cadiz), whence particulars may be obtained.

(*Continued on page 724.*)

SOUTH SHIELDS CORPORATION ELECTRICITY WORKS.

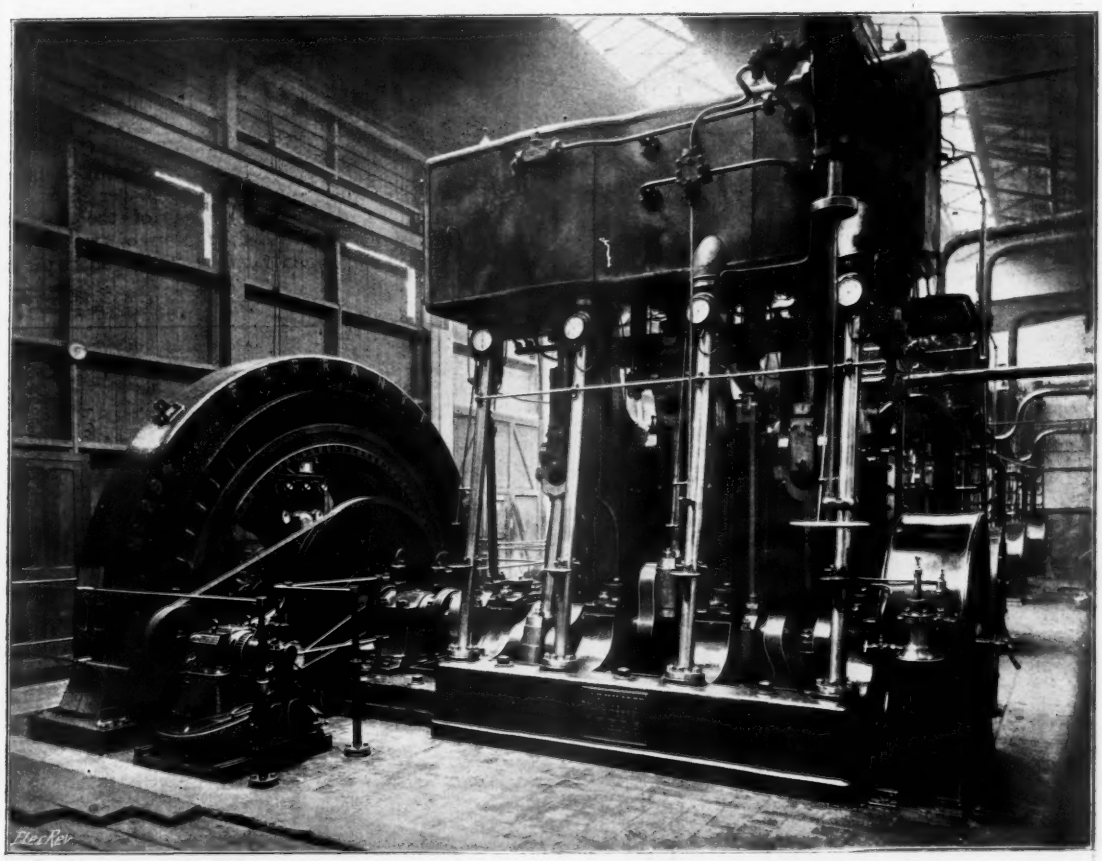
The ancient Tyneside borough of South Shields, although well known to those who go down to the sea in ships, lies in a corner of Durham not often visited by the ordinary business man; yet it is by no means lagging behind the times, and can even give points to its big neighbour, Newcastle-on-Tyne, where alternating current arc lamps are used for street lighting, and the alternators are *not* run in parallel. No one who is familiar with the latter city can have failed to note the occasional momentary blink, often amounting to total extinction, of the glow lamps when the circuits are transferred from one machine to another, or can uphold the street lighting by arc lamps as anything but feeble.

Since 1896, South Shields has been supplied with a 24-hours service of electricity, generated in a station at the riverside at High Shields. The station possesses its own quay, where coal is delivered in barges at the low rate, to Southern ideas, of 8s. 9d. per ton.

The buildings are at present in a transitional stage, large extensions being in progress, while still larger additions have been provided for. The original scheme included engine room, boiler house, and pump room, as well as store rooms and a range of offices; the engine room is being more than doubled in size, and the offices are to be removed entirely to a part of the site facing on an important thoroughfare.

It often happens that a municipality, when first adventuring on the unknown perils of an electricity supply, displays its caution by expending the smallest possible capital upon the undertaking; it is no small testimony to the intrinsic merits of electric lighting, that in spite of this initial handicapping tendency, the vast majority of such undertakings have attained success, and have ultimately absorbed a capital outlay, the bare mention of which, in the preliminary estimates, would have ensured the summary rejection of the scheme! The undertaking here described was no exception to this rule; combining the cautious qualities of Yorkshiremen and Scotsmen, the hard-headed Tynesiders would hear of nothing but a moderate beginning—with the result that the demand has always been ahead of the supply.

The first installation was designed and carried out by Mr. J. A. Jeckell, the borough electrical engineer, who acted as consulting engineer to the Corporation, and the station commenced supply in September, 1896, with but 750 lamps connected. The subsequent progress of the undertaking, under Mr. Jeckell's energetic supervision, is strikingly shown by the following data:—



200-kw. Steam Alternator.

Quarter ending September 30th.	Lamps connected.	Works' cost.
1897	5,969	4·0d.
1898	11,319	2·4d.
1899	22,576	1·4d.

The rate of increase of the lamp connection is evidently almost 100 per cent.; while the handicap due to starting in a small way is well shown in the decreasing works' cost. We

may add that from March, 1897, to March, 1898, the lamp connection was practically at a standstill, because the generating plant was loaded to its maximum safe limit, and the new plant, which was on order, was delayed by the engineers' strike; in spite of this, however, the undertaking has paid over 6 per cent. per annum on the total capital expended since September 30th, 1898, *i.e.*, two years from the commencement of supply. The original scheme was estimated to cost £28,000; up to the present the capital expenditure has amounted to £75,000, and when all the contracts for extensions are completed the sum total will be £110,000.

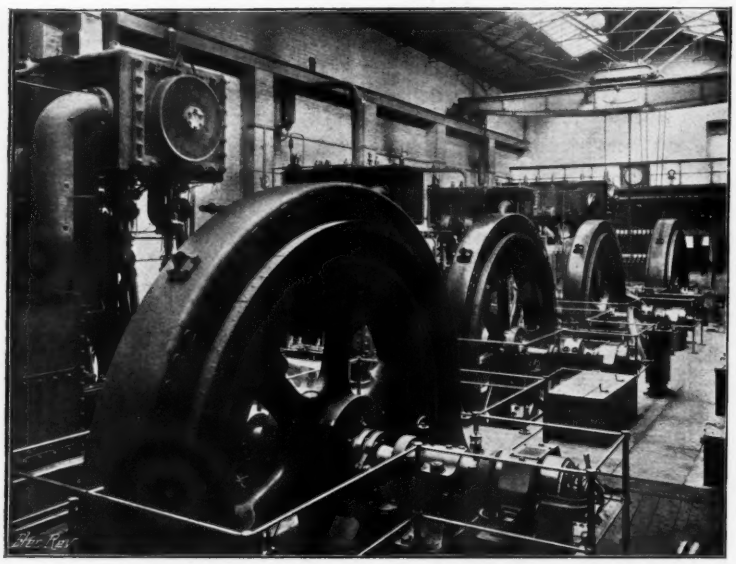
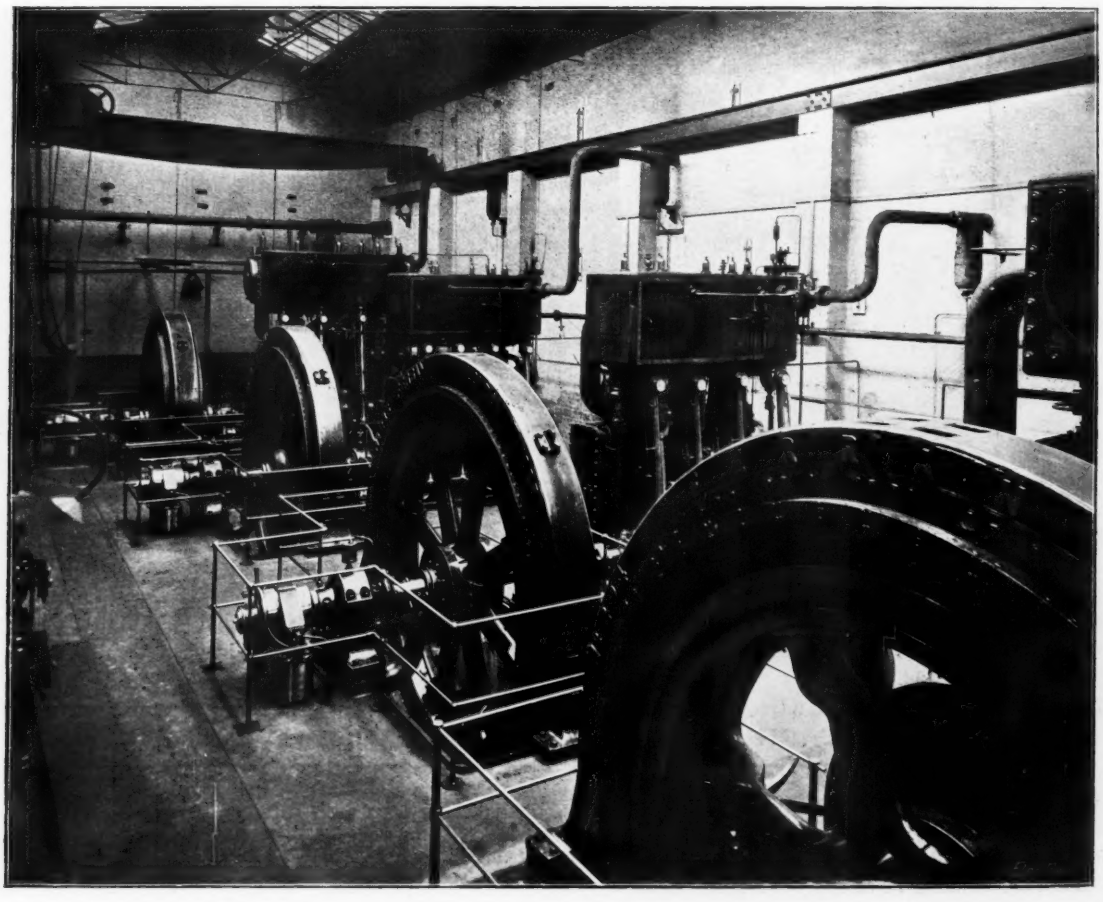


Photo by] [Parry.

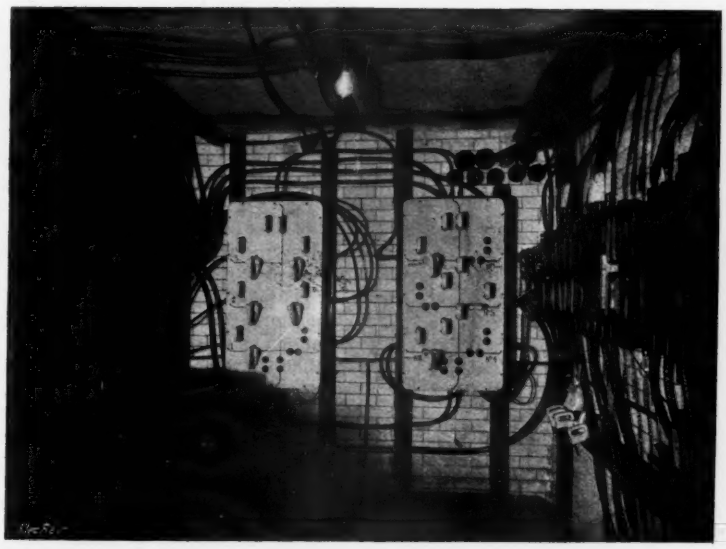
Engine Room, Looking towards Switchboard.

The first thing noticeable about the plant is its compactness, if it is not, indeed, crowded. This, no doubt, results from the strong marine engineering bias of the Tynesiders. The boiler house adjoins the quay, and contains three marine boilers, each 11 feet diameter × 10 feet 6 inches long, and capable of evaporating 5,000 lbs. water per hour at a pressure of 160 lbs. per square inch. The curved part of each boiler is made of a single plate, there being no circumferential seam in the centre; there is no brickwork about the boilers, but each is provided with a steel chimney 40 feet high, which affords an excellent draught. Two of these boilers are by Messrs. Black, Hawthorne and Co., the third by Messrs. Robert Stevenson & Co. An additional boiler, 14 feet 6 inches diameter × 10 feet 6 inches long, capable of evaporating 10,000 lbs. per hour, is about to be installed; this is made by Messrs. Eltringham and Co., South Shields. All the boiler fittings are of the Hopkinson type. Feed water is provided by means of two compound Worthington pumps, each rated at 2,000 gallons per hour, but capable of 50 per cent. larger output. For surface condensing, similar pumps, of the vertical type, lift water



General View of Engine Room.

18 feet from the river, and deliver 25 feet to a tank overhead, whence the water flows by gravity through the condensers. Each of these pumps can raise 30,000 gallons per hour; they are situated at the east end of the boiler house in a special pump room. A new pump, of the fly-wheel type, capable of raising 80,000 gallons per hour, is to be put down in the same room, while the feed pumps are to be removed and installed with a new Weir pump in the same end of the boiler house; a Weir evaporator is already in operation, supplying the make-up water for the boilers, as the water supply is too bad for direct use. A grease separator is also to be installed. There are two separate hot-wells, and the feed piping is completely duplicated. A separate condenser is used for the auxiliary plant.



Sub-Station.

The steam piping, of steel, with copper bends, is arranged as a ring main, though this is not regarded as a desirable arrangement, simple duplicate supply being recommended; it is found that, unless the *whole* of the ring main is kept hot, the unequal expansion of the hot and cold legs causes the joints to start, precipitating the very troubles which it was sought to avoid.

Very large steam separators of simple design are connected with the steam range on both legs, and a similar one is applied to each engine.

The generating sets at present installed are four in number, each consisting of a Ferranti alternator coupled to a McLaren engine. Two of the sets are rated at 100 KW., and two at 200 KW. each; the alternators have magnet fly-wheels and stationary ironclad armatures, working at 2,000 volts, 50 periods per second, 125 revolutions per minute. The construction of the magnet wheels is striking; each fly-wheel was made in halves, the arms being separate at the hub to prevent internal stresses; the shaft was erected in position, the fly-wheel mounted thereon, and steel rings shrunk on projections from the arms next the shaft, binding the whole together. There is no feather or key, the wheel being driven by friction only; although the parts had never been assembled before, they fitted perfectly in every case.

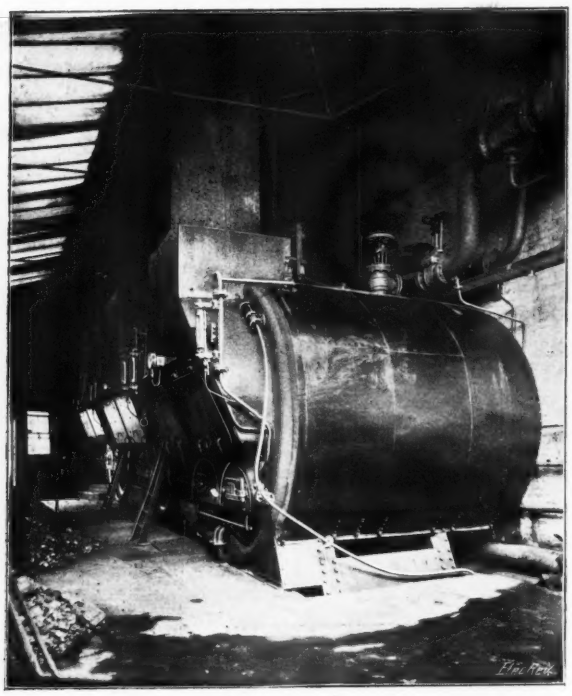
Rectifiers and Arc Switchboard.

The alternators are driven by triple expansion three-crank vertical marine engines of the open type, made by Messrs. McLaren, of Leeds; they all run at 125 revolutions per minute, with a piston speed of 500 feet per minute, and these standards will be adhered to in carrying out extensions. Each engine is combined with its own surface condenser and air pump, a system which possesses obvious advantages; a vacuum of 26 inches of mercury is easily maintained or even exceeded. There is a duplicate service of condensing water.

The speed of the engines is controlled by McLaren's patent shaft governor, which can be adjusted while the engine is running. Forced lubrication is adopted in the main alternator bearings, which are separate from the engine bearings, by means of small pumps driven by eccentrics on the shaft. So free is the running that we were told one day a 200-KW. set ran for ¾ hour after steam had been shut off, both at the engine stop-valve and at the steam range. A new engine room has been erected adjacent to the old one, large enough to accommodate four 500-KW. sets of similar type; foundations have been put in for two of these, the alternators being supplied by Messrs. Siemens Bros. & Co., and Messrs. T. Richardson and Sons, Hartlepool, respectively, with McLaren engines. Still larger extensions are contemplated, and Mr. Jeckell has prepared the plans for four 1,000-KW. sets in

addition to those mentioned; a row of 12 boilers is to be laid down on the outer side of the extended station.

A 10-ton travelling crane, by Messrs. Marshall, Fleming and Jack, of Motherwell, spans the present engine room; a 15-ton crane is being erected in the new engine room by the Dumfries Iron Company.



Boilers.

Along one side of the station are arranged three Ferranti rectifiers, with the arc lighting switchboard; one rectifier is a stand-by, but another will shortly be added, and a third arc lamp circuit connected up. The performance of these machines has given complete satisfaction; we were informed that this can only be ensured by devoting great attention to them and keeping them in first-rate order.

The main switchboard consists of 30 panels of the Ferranti standard type; these are divided in the middle so that the board may be worked as a whole, or either half independently of the other. The board has recently been doubled in size, the new portion being, in fact, as yet unfinished. Duplicate oil fuses are used, so arranged that one can be substituted for another, or a new one inserted without interrupting the circuit or short-circuiting the contacts, and with perfect safety to the operator. Each alternator and feeder is in series with an edge-wise ammeter of Messrs. Ferranti's manufacture. The rheostats for controlling the excitation of the alternators are below the switchboard, and the regulating hand-wheels are so arranged that they rotate in the same direction as the pointers of the voltmeters over the switchboard, thus ensuring the collaboration of hand and eye in paralleling.

There is nothing combustible near the switchboard; the floor is of concrete, and the ceiling above is protected by slate slabs. The importance of avoiding the use of wood near switchboards, and even upon them, we have emphasised before. In this case exceptionally low terms were obtained from the insurance offices, on account of the fireproof nature and absolute safety of the construction.

Each alternator has its own exciter. There was an additional exciter for stand-by, with a two-way switchboard, to enable any alternator to be excited, either from the spare machine or from its own, but this was never required, and has been put out of gear.

A Thomson-Houston watt-hour meter is in series with each machine; no other watt-hour meters are used in the station. Mr. Jeckell finds that the average total loss in circuits during the year practically does not exceed 2½ per cent. of the capacity of the transformers installed.

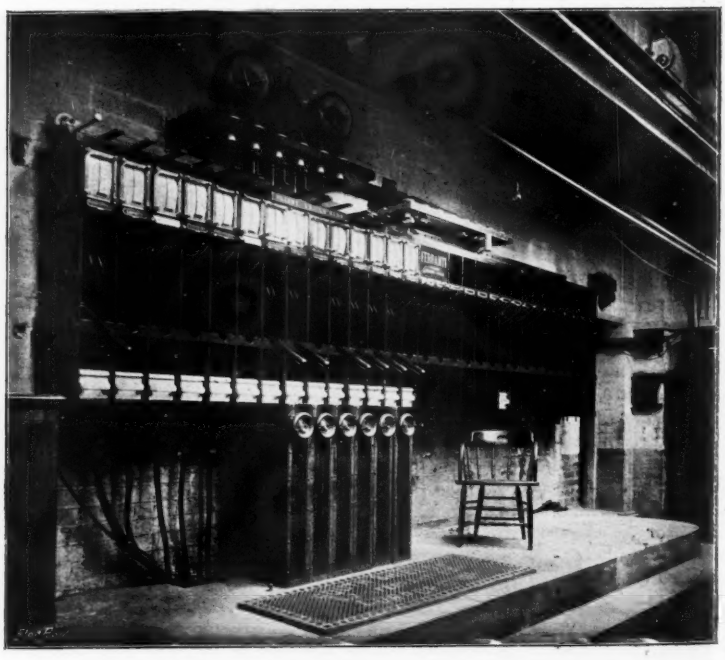
Great care has been taken to ensure safety to the switchboard operators. The main board is mounted on a platform raised above the general floor level, from which all unauthorised persons are excluded, and a teak dais runs along in front of the rectifiers, on which the attendants stand.

The test room opens from the dynamo room, and is equipped with a set of Kelvin ampere gauges reading to 2·5, 20, and 100 amperes respectively, as well as Kelvin multi-cellular voltmeters reading to 100 and 250 volts.

The public lighting is done with 70 12-ampere Brockie-Pell arc lamps, 60 of which are divided between the two rectifier circuits, and 10 are supplied from transformers; 20 more public lamps are to be added with rectified supply. The arc lamp-posts are of graceful design, and were supplied by Messrs. Allen, of Glasgow. The arcs are cut off at 11.30, before which hour the police turn on glow lamps, two of which are carried on each arc lamp-post; a great advantage of this system lies in the fact that, in case of mishap to an arc lamp, the police switch on the glow lamps and report the trouble.

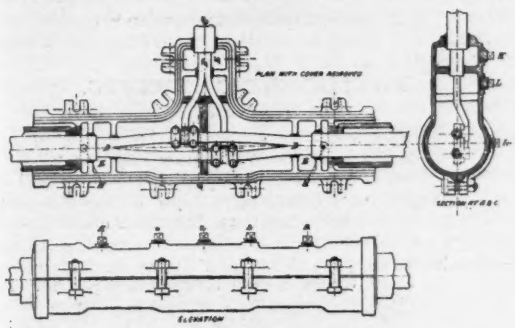
The distribution to private consumers is carried out by means of sub-stations, of which two are at work and five in course of construction. In the early days, transformers in street boxes were used; these have now been removed to outlying districts where the demand is more scattered.

Mr. Jeckell was formerly opposed to sub-stations, which he described as "damp dirty holes"; when, however, the exigencies of the demand rendered them practically inevitable, he determined that his own sub-stations should not be of the above description! They are all of standard size, 17 feet long × 9 feet wide × 9 feet deep, with an entrance shaft 3 feet square at one end—this was found necessary to prevent the entry of rain when the station was opened in wet weather. The walls are double, of 9-inch brick outside, 9 inches inside, with a 3-inch space between, and lined with white glazed bricks. The inner wall is made waterproof with compound in the middle of its thickness, and the cavity between the walls is drained. A 4-foot square copper



Main Switchboard.

plate is buried in coke and damp earth under the station, to which a 1 inch × ⅛ inch copper tape is riveted and soldered; the ends of the tape are brought into opposite sides of the chamber and riveted to a similar conductor running round the latter, which is used as the earth connection for all purposes, and ensures a doubly reliable path to earth.



D D, cables; E E, stuffing boxes; K, L, plug holes.

Jeckell Junction Box.

Each sub-station is supplied by a separate feeder from the works; two other feeders are tapped also, for a stand-by; the secondary network from each station is independent of the others, but can, if required, be joined up at once by means of street switches. There are six 30-KW. transformers in each chamber, one of these being spare; this is a larger capacity than is usually permitted for a single station, but Major Cardew passed the designs on account of the precautions which had been taken to ensure the safety of the operators. There are two high pressure boards, one connected with the feeders, the other with the transformer primaries; all feeders come in on the right-hand of the feeder board, and those going on to other stations leave on the left-hand. There are 10 low pressure circuits from every sub-station, each provided with a disconnecting fuse, and one ammeter, which can be put in any circuit.

Messrs. Ferranti supplied the high pressure, and Messrs. Fowler, of Leeds, the low pressure switch gear for the new sub-stations.

All the sub-stations are exactly alike in accordance with Mr. Jeckell's maxims, "simplicity and standardisation," which are in evidence in every department of the system; in this connection we may mention that we ourselves insisted on these two points in a leaderette last week.

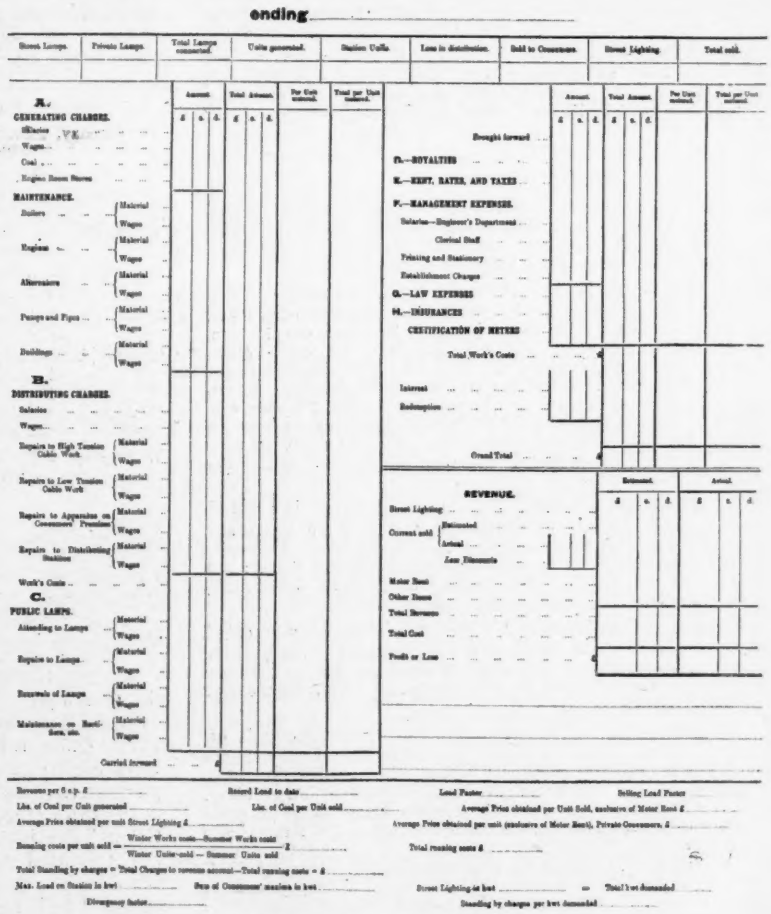
The mains are chiefly of the British Insulated Wire Company's manufacture, concentric and lead covered. Formerly vulcanised rubber insulated cables were employed, but these have been dropped, solely on account of their greater cost. The cables are drawn into cast-iron pipes, one in each, these being found cheaper than earthenware ducts for use in Shields, except where there are more than three ducts together. The pipes have the advantages over armour, that they can be laid without opening great lengths of roadway to see if the cable must pass under any obstruction; they afford facilities for removing faults; and they are not damaged by picks. A special junction box, designed and patented by Mr. Jeckell, and made by Messrs. Smith, Patterson and Co., of Blaydon-on-Tyne, is used for house services; our figure shows the details of the box, as used for twin cables. The pipes are cut where a service connection is required, the joints made, and the lower half of the box adjusted in place with wood brackets to separate the conductors. The cover is then bolted on and the box filled up with compound. These joints are only intended for low pressure work, but have been tested up to 2,500 volts successfully. The holes, H H, are left open to relieve the joint of water-pressure in the event of water gaining access to the pipes on a slope.

All the high pressure mains are eventually to have a cross-section of 0·15 square inch; the low-pressure distributors are to be of 0·15 square inch for 220 volts, and 0·25 for 110 volts, both pressures being in use. About 10,000 yards of mains have been laid this year, and large extensions are in progress; all mains are being laid by Corporation workmen. The system now in hand provides, in fact, for an output of 2,500 KW.

Disconnecting fuse-boxes are put in consumers' houses, but no double-pole switch is stipulated for. Teak meter boards on insulators are used, with either Thomson-Houston watt-hour, or Chamberlain & Hookham ampere-hour meters.

The Wright method of charging is in use throughout the system, at the rate of 7d. for the first hour and 2d. afterwards.

The system of keeping the log-sheets devised by Mr. Jeckell is specially interesting; to make it clear we reproduce a page of the log-book. This volume contains 52 pages headed "Week ending," &c.; 12 headed "Month ending"; 4 headed "Quarter ending"; 2 for the half years, and 1 for the whole year. Every week the particulars in the body of the page are entered; these are summarised every month, then again every quarter, and so on; the last page, practically without further treatment, constitutes the Board of Trade returns. The system appears to be almost automatic, and it is obvious that the chief engineer can by its means at any time ascertain the exact condition of affairs to date, and the progress of the undertaking as compared with previous years, with perfect ease. The particulars contained in the lower portion of the



Typical Page from Station Log-Book.

page are not required except at the half years, &c., but are retained throughout for the sake of uniformity. Loose sheets, identical with those in the log-book, are handy for furnishing periodical reports, &c.

In conclusion, we have to express our obligations to Mr. Jeckell, the borough electrical engineer, who spared no pains to impart to us full information on all points, as well as to Mr. Robertson, assistant engineer, and to Mr. W. Parry, for permission to make use of a photograph of the works.

CONTRACTS OPEN AND CLOSED.

OPEN.

(*Continued from page* 718.)

St. Pancras.—The Vestry wants offers for the supply of temporary generating plant for the Regent's Park electricity works. See "Official Notices" October 20th.

Swansea.—November 20th. The Corporation wants tenders for five Lancashire boilers with jet condensing plant, feed pumps, economiser, piping, &c., for electricity works. See "Official Notices" this week.

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wolverhampton.—November 13th. The Lighting Committee wants tenders for two 500-KW. direct coupled generating sets for the electricity works. See "Official Notices" this week.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works. See "Official Notices" October 13th.

CLOSED.

Blackburn.—The Blackburn Corporation has placed orders for 40 60-passenger cars with the British Thomson-Houston Company, and 20 60-passenger cars with Dick, Kerr & Co., to the specification of Messrs. Lacey, Clirehugh & Sillar.

France.—The French Post and Telegraph authorities in Paris have just given out contracts for 200 tons of copper wire, 4 mm. in diameter, as follows:—La Compagnie Francaise des Metaux, Paris, 50 tons at 2,215 francs per ton; Messrs. Lazare, Weiller & Co., Paris, 50 tons at 2,220 francs; and La Société d'Electro-Metallurgie, Paris, 50 tons at 2,149 francs, and 50 tons at 2,097½ francs. Messrs. Lazare, Weiller & Co, are also to supply 250 tons of copper wire 5 mm. in diameter at from 2,210 francs to 2,240 francs per ton. La Société Francaise d'Electro-Metallurgie, 100 tons ditto. at from 2,049 francs to 2,097½ francs, and La Compagnie Francaise des Metaux, 50 tons ditto. at 2,190 francs.

Germany.—The municipal authorities of Dortmund lately called for tenders for the supply of a 1,000-H.P. engine and dynamo required for the extension of the central station. The lowest tenders submitted were: for the engine, £3,162, Messrs. Borsig; and for the dynamo, £2,200, the Allgemeine Electricität's Gesellschaft, both of Berlin.

London.—The Battersea Vestry on Wednesday accepted the tender of Messrs. J. G. Jones & Co., amounting to £860, for the stanchions, columns, and cantilevers required for the electric light station, and that of Messrs. H. Young & Co., at £3,797, for the steel girders, joists, and bolts.

Salford.—At the meeting of the Town Council on Monday the tender of the Westinghouse Electric Company for the supply of 100 tramcars at £534 10s. per car was unanimously accepted. Alderman Linsley thought the car selected was the best in the country. The tender of Galloways, Limited, for boilers and fittings required for the Strawberry Road electric station, amounting to £15,200, was also confirmed.

The committee is arranging to set lines in Cross Lanes and Trafford Road, which it is thought will be a capital training ground for car-drivers.

Shoreditch.—The Vestry of St. Leonard, Shoreditch, has accepted the estimate of Messrs. Buck & Hickman for supplying the necessary engineering tools, including a lathe, the amount being £152.

Waterloo-with-Seaforth.—*Tenders and Contracts* says that the following tenders have been accepted by the District Council for the supply of steel rails, construction of about 1 mile 5 furlongs of tramway track, and laying of about 2,806 superficial yards of wood paving and 26,147 superficial yards of granite sett paving. Points and crossings: Askham Brothers & Wilson, Sheffield. Rails, fish plates, joints, and tie-bars: P. and W. Maclellan, Irongate, Glasgow. Paving road and laying tramway track: Nuttall, Old Trafford, Manchester.

Wigan.—The Council has resolved that the tender of Messrs. Picksley, Sims & Co., Leigh, for £586 4s. 2d., for iron and brass castings, be accepted.

FORTHCOMING EVENTS.

Friday, November 3rd.—At 8 p.m. The Institution of Junior Engineers, at the Westminster Palace Hotel. Presidential address by the Hon. Charles A. Parsons, F.R.S.

At 7.30. At Newcastle-on-Tyne, first meeting of the session of the North-East Coast Institution of Engineers and Shipbuilders.

Monday, November 6th.—At 7.30 p.m. Society of Engineers at the Royal United Service Institution, Whitehall. Paper on "The Electrolytic Treatment of Complex Sulphide Ores," by Mr. Sherard Cowper-Cowles. Synopsis:—

Introduction—Cost of distillation process—Characteristics of sulphide ores—Watt's process—Diffenbach's process—Ashcroft's process—The Siemens-Halske process—Hoepfner's process—Mohr's process—Swinburne's process—Cowper-Coles's process—Crushing, Roasting, and Screening the ore—Zinc leaching—Treatment of fines—Epuration tanks—Electrolysing cells—Best form of cathode—Best material for anodes—Zinc deposition—Effect of copper in the electrolyte—Zinc sponge—Cost of depositing zinc—Weight of zinc deposited—Manufacture of zinc white and zinc sulphate—Manufacture of white lead—Diagram of the Cowper-Coles Cyclical process.

Tuesday, November 7th.—At 8 p.m. Institution of Civil Engineers. Address by Sir Douglas Fox, president, and presentation of medals and prizes awarded by the Council. Reception by the President in the library after the meeting.

Friday, November 10th.—At 5 p.m. Physical Society meeting in the Physical Laboratory of the Central Technical College, Exhibition Road, South Kensington (by kind invitation of Prof. Ayrton, F.R.S.) Agenda.—1. "Contact Electricity." By Mr. F. S. Spiers. 2. "On the Heat of Formation of Alloys." By Mr. J. B. Taylor.

Tuesday, November 14th.—Institution of Civil Engineers. "The Waterloo and City Railway," by H. H. Dalrymple-Hay, M.Inst.C.E.; "The Electrical Equipment of the Waterloo and City Railway," by B. M. Jenkin, Assoc.M.Inst.C.E.

Wednesday, November 15th.—Society of Arts opening meeting. Address by Sir J. Wolfe Barry.

Thursday, November 16th.—At 8 p.m. Institution of Electrical Engineers' opening meeting. Presentation of premiums and inaugural address, by President S. P. Thompson, F.R.S.

Tuesday, November 28th.—Manchester Society of Junior Electrical Engineers. Meeting at Deansgate Hotel, Manchester. Paper by Mr. J. H. Henderson on "Aluminium, Its Treatment and Use, as Applied to Electrical Engineering."

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

NOTES.

Science Gossip.—The writer of "Science Gossip" in the *Athenæum* for the present week begins his polite chatter by calling attention to the ways of the librarians at the Patent Office Library. He has this against them, that the Royal Society publications bearing the date of January are not put upon the library table until late in October. This, of course, is a horrible crime, but, unfortunately, the writer of "Science Gossip" has jumped upon the wrong criminal. No doubt the *Athenæum* receives the Royal Society publications on the date of publication, and the editor is probably aware of the "lag" between the date printed on the cover, and the date of arrival at his office. It is one of the idiosyncrasies of those responsible for Royal Society publications. The fact that the publication in question, dated January 23rd, was only in our own hands this week, enables us to vindicate the librarians of the Patent Office Library. For our own part, we have nothing but praise for them; notwithstanding the heavy work entailed by the change of premises, they are always able to find you the book you want, and to help you to a reference.

Thawing Out Pipes by Electricity.—The *Canadian Engineer* gives some particulars as to the current needed to thaw out water pipes by electricity by the system of Wood and Jackson, who report that to thaw out a 1½ service pipe of iron or of lead requires 200 to 250 amperes. With 125 amperes it will require four times as long to effect the same result, and with over 250 amperes there is liable to be excessive heating of brass connections. Iron pipe must be carefully watched to avoid overheating at joints. A transformer has ordinarily been used, but in some cases dynamos have been employed direct. The source of current should have not less than 50 volts pressure. To thaw out 500 feet of 6-inch main in half an hour demands 800 amperes. This will also serve for 500 feet of 12-inch main if applied for one hour and so on, and for mains the source of current should have at least 200 volts pressure. In thawing mains connection is made to two hose nozzles, screwing the wire hard up by means of the cap. After thawing water must be run for half an hour. Three-quarters of 1 H P. per foot of pipe for half an hour is the power necessary for a 6-inch main; $\frac{2}{10}$ H.P. will serve a 1-inch pipe, and ¼ H.P. will thaw out a ⅝ service pipe on the same basis. In thawing out a house service connection is made to the service in the house and to the street main, and the lead in the house is in series with iron plates in a bucketful of salt water as a variable resistance to adjust the current. Thus if the transformer primary has 2,000 volts, the secondary 50 volts, the current should be, say, 15 amperes. Water usually begins to flow in from 10 to 60 minutes. The operation will not damage the pipes, though it will frequently reveal splits. The value of the system is stated to be considerable, for the loss in 1898 to insurance companies was $300,000, caused by primitive methods of thawing out pipes. We suppose it would be too much to expect a London water company to use such a modern method. As a rule, our London companies confine their energies principally to making up high bills, but the supply of water is hardly considered worthy of notice.

Obituary.—The *Times* says that last Friday information reached the School of Military Engineering, Chatham, by cable from Teneriffe, of the death by drowning of Major (local Lieutenant-Colonel) A. E. Wrottesley, Royal Engineers, in command of the telegraph battalion now on its way to South Africa. Colonel Wrottesley embarked at Southampton the previous Saturday with his men and equipment. He had just been gazetted Director of Telegraphs with the Army Corps under Sir Redvers Buller, and was accorded local rank of lieutenant-colonel while so employed. Previously he commanded the Second Division Telegraph Battalion Royal Engineers. Colonel Wrottesley entered the Royal Engineers, at the age of 19, in 1874. He had no war service.

The Automobile Situation.—Mr. H. P. Maxim's statement in *Cassier's Magazine* as to the electric cabs in London, does not come very *apropos* when the whole 40 appear to have been withdrawn—not, it is to be hoped, permanently. There are, he says, 100 cabs in New York, and a few in Paris, and numerous privately-owned automobiles also. In Paris 95 per cent. of private motor vehicles are propelled by "moteurs à pétrole." The same is true of the light delivery wagons. The remainder are propelled by steam or electrically. It is possible to buy in America an electric carriage for two or four persons of a capacity of 30 miles on ordinary grades at an average speed of 11 miles per hour. The load of an electric delivery wagon must be under 1,000 lbs., and the mileage must not exceed 30 if electric power is to be the best possible. Above 30 miles, gasoline or steam must be employed, and it is claimed by Mr. Maxim that American vehicles are the best. We are doubtful of this claim. Gasoline averages 7½d. per gallon in America (we suppose the gallon meant is the American gallon of about 8 lbs. of water). Lubricating oil, to the amount of a pint for each 50 to 100 miles, is required at a cost of 20d. per "gallon;" above 1,500 lbs. of load, steam appears still to hold the palm. Numerous illustrations serve to point the present status of automobile construction, but but very little technical information is forthcoming. It would be of interest if a clear and technical description of a modern gasoline car could be written to inform engineers generally of the present condition of the art of automobile construction in respect of the use of heaters and coolers and the many details of construction that have failed and succeeded and the reasons for such failure. Very few understand the automobile, and we fear that many who do know much about them are too little used in general engineering knowledge and practice to be capable of correctly judging their own pet vehicles. The motor car is progressing, but it has not yet emerged thoroughly from that stage which may be compared with the sealing wax stage through which the dynamo passed.

Personal.—Mr. J. Clifton Robinson, the very popular tramway magnate who has been so prominent a figure in the electric tramway world ever since this country entered the van of progress, is the subject of an interesting article on "Modern Advance in Public Conveyance" in the *British Journal of Commerce*. Mr. Robinson, who is a most interesting personality to those who know him, may claim for himself the honour of being the first to shake the strongholds of our conservatism in regard to street traction, and to arouse us from our drowsiness. Those who have watched the progress of his schemes at Dublin, London and elsewhere, know well that only a man with dogged perseverance and an aggressive disposition, such as he possesses, would have continued in the face of the disheartening difficulties against which he has had to contend. Perhaps we have uttered forth our diatribes against municipal ignorance in regard to electric traction somewhat frequently, but we think never without cause or justification, and we suppose Mr. Robinson has had more experience than anyone else of the unreasonableness, we had almost said pigheadedness, of municipal opposition. From the article before us, we observe that Mr. Robinson has been connected with horse, cable, or electric traction for close upon 40 years. We suppose this is not far off being a record. It is significant to remark that he has discarded cable working, and now pins his faith exclusively to electricity.

Mr. Eugène Aimé Barbarat, Government inspecting engineer of the electric service in the Paris district, has been appointed engineer-in-charge of the Submarine Telegraph Service of France, and of the Repairing Works at La Seyne, near Toulon. Mr. Barbarat succeeds Mr. Morris, who has for a long period been at the head of the Submarine Service, and now retires on pension.

Mr. A. H. Gibbings has resigned the post of city electrical engineer at Bradford. The Cleckheaton District Council has engaged him to act as its consulting engineer, and he is still negotiating with the Southend Corporation for their provisional order.

Gas Explosion at Manchester.—Manchester has been somewhat alarmed lately because of the recent mishap at the Corporation electricity works. On that occasion the public suffered some amount of inconvenience, but the personal injuries to the staff were practically *nil*. As fortune would have it, the rival lighting department of the Corporation, namely, the gasworks (Rochdale Road branch) has now followed suit and done its level worst. Were it not that the injuries to the staff have proved fatal in one case, and extremely serious in others, there might be some humour in the situation. The effects certainly appear to be more disastrous than those of any electricity works accident that has ever occurred in this country. An explosion in a 24-inch gas main set fire to the meter house and the tower; the manager of the branch lost his life, the deputy manager was severely burned, and 11 assistants were also injured.

Marriage.—On October 26th, Mr. Charles Bright, F.R.S.E., was married at St. Mary's, Farnham, Essex, to Isabella Charlotte, daughter of the late Mr. Robert Gosling, of Hassobury, Essex.

Incrustation of Iron Pipes at Torquay Waterworks.—Mr. Ingham's paper before the Institution of Mechanical Engineers will be chiefly useful to electrical engineers for its useful information on the rusting of pipes, which may be applied in respect of the many pipes and tanks necessary at some stations. The curious manner in which rust manifests itself is well known. The most familiar form is that of the nodule, little mushroom growths of red rust, which on being cut open reveal an oxidised pit beneath. The growth of nodules only $\frac{1}{8}$ or $\frac{3}{16}$ high soon reduces a 10-inch pipe to the capacity of one of 9 inches owing to the increased skin friction. Pipes are scraped by means of "go devils," a rotary system of scrapers actuated by the flowing water itself, and the first scraping of a pipe usually brings to light all kinds of rubbish—lead from joints, stones, bits of broken pipe, an occasional shovel or piece of wood, and generally such articles as children are so fond of throwing into pipes as they lie along the roadside. Nodules of rust contain 49 per cent. of metallic iron, and a 12 months' rust may amount to 21 tons of iron lost from about 14 miles of pipe. The author states that a pipe originally coated with Angus Smith's composition was scraped in 1896, and whereas it had been delivering 516 gallons per minute it afterwards delivered 663 gallons, a difference of 28½ per cent. From this 10-inch pipe in a course of eight miles the scraper collected 35 lbs. of joint lead, some yarn, and a bucketful of stones. Eight miles were scraped in three hours, and six miles in another three hours, an average of 2½ miles per hour. At the 14 scouring valves, in the course of the 14 miles, each valve is left open after the scraper has passed, until the water runs clean. This requires sometimes 20 minutes. It is found that high water velocity is favourable to corrosion and incrustation. Cast-iron being taken to rust at the rate of 100, wrought-iron may be taken as 129, and steel at 133. Some waters, as chalk-well waters, treated by Clark's process, will simply cause a clean layer of carbonate of lime inside a pipe. Upland waters, especially if containing peat acid, cause rust. Old red sandstone water neither rusts nor causes deposit. Greensand water causes rust. Filtered water is better than unfiltered. Angus Smith composition is not a permanent protector. At Torquay six years is the outside limit of protection. We agree with the author that founders do not exercise proper care in dipping pipes. Our own opinion is that pipes ought to be well brushed out, by passing through them a revolving steel brush *from both ends*, so as to get the brushing effect each way, and they should be then at once heated and dipped. Dipping should be vertical, and the pipes ought to again be brushed by the revolving steel brush when immersed in the dip, without which treatment perfect contact may be difficult to secure between the iron and the composition. It is undoubtedly at the pinholes, caused by minute air bubbles, that the first encroachments of corrosion are made upon the pipe.

To Central Station Engineers.—In view of the importance of fuel economy in central stations, and the fact that such economy can always be secured where it is possible to purchase bituminous coal at considerably less prices than Welsh smokeless, it appears probable that many central station engineers may wish to put on record in our columns some of their experiences on this question, especially in respect of the means taken to burn bituminous coal with a minimum of smoke and the arrangement and type of boilers most suitable for the purpose, together with particulars as to rates of combustion and evaporative effects obtained. Such information cannot fail to be useful and valuable for the profession generally.

Death from Electric Shock.—We read in provincial papers that an inquest has been held at Eston Junction with reference to the death on 27th ult. of D. J. Evans, from an electric shock at the Cleveland Steel Works. Deceased was employed in the mill department, and had fallen asleep. On awaking, he yawned and stretched out his arms, and one of his hands came in contact with the wires connected with the electric lamps for lighting the works. He instantly dropped, and was picked up quite dead. The inquest was adjourned for the attendance of the factory inspector.

Mr. Barnes on American Competition.—Mr. Geo. N. Barnes is progressing. He has been allowed to air himself in the pages of *Engineering*, and has described himself as a representative British workman! He is asking what we have asked repeatedly—that our workshops shall be equipped to the height of excellence in the way of tools, methods, and machinery generally. This is excellent. He did not seem to see things thus in 1897. No one is so much to blame as Mr. Geo. N. Barnes for the use of out-of-date plant. His own followers were never allowed to do so much work in a day as any old tool would easily do. Why, then, should better tools have been bought? Then he grumbles—sensibly, too—about the early morning's start. We can assure Mr. Barnes that we know of one shop which was working 50 hours weekly before the A.S.E. broke in on it and demoralised every man in it. The men in this very shop refused the offer of a start after breakfast. True, they had an excellent reason in the lack of facilities offered by the railroads. Men like Mr. Barnes have had a great deal to do with the London County Council, and it is this same Council, so solicitous for the working man, that has deprived London working men for years to come of the only effective competition with the sluggard steam railroads. Need we say that had the County Council willed it, every main road leading out of London would, and might to-day, have had its trolley road, and the early morning start might have been abolished? Mr. Barnes's fellow agitator is on the County Council. Why does he not agitate for electric tramways in place of needless experiments and the delays incidental to the conduit system? Finally, let us make a note—it may be useful to refer to when Mr. Barnes again stirs up a strike against machinery—he states that machinery and workshops of the latest type are absolutely necessary, and should be honestly used. Note the honesty! Does Mr. Barnes mean at last that machinery should be allowed to do what it will do? Does he discountenance the running of a lathe with the tool not cutting, and such tricks of trades unions? When a friend of ours was waited on by a deputation from Mr. Barnes, he offered to run his shop six hours a day at the same day's wages as paid for eight hours if Mr. Barnes would guarantee one hour's honest work per day. We may not be just to Mr. Barnes, he may mean all he now says; but we have made contact with his methods and his organisation; we have seen the brutality his society exercised on weaker labouring brethren, and were we to live a century we could never forget it all. Much of what he now writes, may be, is true. He is late in writing it. With much we absolutely agree. We regret that he did not hold the same opinions three years ago, and we think few who knew of his works in 1897 will accept his article with different feelings.

"Special!"—Our 'cross-the-way contemporary *Electricity* is always happy on its birthday, and it shares its mirth with its readers by dealing out to them a special issue with special articles by special men. Mr. Robert Hammond writes a few notes regarding the quarter-million electricity scheme at Hackney, for which he is consultant; Mr. A. P. Haslam continues his articles on the 1898 electrical energy costs, and gives many pages of tables, &c., showing the comparative outputs and costs for municipal plants; Mr. Charles R. Gibson has something to say about the relation of magnetism to electricity; Mr. W. H. Booth contributes some very brief comments on "superheated steam essential to economy in the generation of electrical energy"; Mr. Bathurst indulges in a reverie on the topic upon which we think he has written before, viz, "Electric Wiring"; the Cairo electric tramways are illustrated and described; Mr. Howard Little also has some suggestions regarding wiring; and last, but not least, we find some remarks from the pen of Mr. H. Scholey on the importance of the electric motor to the proper development of the electricity supply business. From "Ourselves" there is an outstretched hand for the entire electrical profession, followed by a special curtsey to the electrical press and others who have contributed to our thriving contemporary's prosperity. There is a dash of repentance in an otherwise well-filled cup of confidence, in the promise of doing better in the future than in the past. The editors of *Electricity* are to be congratulated upon the choice of subjects of current interest, and the publishers upon the high-class quality of the printing and illustrating work.

Lillie Evaporator.—Economy of fuel has been so studied in sugar manufacturing, that in the best works all the heat and power on a cane estate are obtained from the megass, which is by no means a fuel to be despised. One of the principal economies is the system of triple effects, which are simply low pressure evaporators. In the Lillie apparatus of McOnie, Harvey & Co., of Glasgow, the exhaust steam from the engines in the factory is the heating agent in the first evaporator, which is a vessel containing copper tubes laid horizontally. The sugar juice drops from tube to tube, steam passing through the tubes. The hot water of condensation, and the steam or vapour driven off the syrup, pass into the tubes of the second vessel, and evaporate the syrup in that vessel, while the third vessel, at the lowest temperature of all, is similarly supplied with heat from the second vessel, and its syrup is under vacuum, so that the final low temperature heat is thereby enabled to effect an evaporation otherwise impossible. To make 1 ton of sugar by the old system of direct firing called for 1 ton of coal, besides all the megass. With these triple effects concentrating in vacuo no coal is needed, there is less waste made, and the product is better. The same principle might with advantage be applied to make up the inevitable losses of water which occur with surface condensing steam engines. There is always some water required to make up loss of steam at glands and gauge cocks and safety valves. This water may be, and is, made good by evaporation. But it is not necessary to evaporate at atmospheric pressure. By placing the evaporator in connection with the surface condenser a constant supply of fresh water might be produced by allowing the exhaust steam from the engines to traverse the evaporator on its way to the condenser. The evaporator would assist the condenser, and the unavoidable accumulation of scale could be easily dealt with. By adding suitable materials the scale would be prevented from crystallising as a hard mass and the evaporator could be readily cleaned. The temperature of a surface condenser may be 120°. If connected near to the air pump the evaporator will be able to extract considerable heat from the engine exhaust, which will have a temperature higher than the water and the evaporator. Or the evaporator may be placed in the flues—even between the economiser and the chimney—and will utilise heat now sent to waste. It can be of light construction, and fed simply by a ball valve. It should certainly be possible to obtain the make-up water supply without expense of live steam or fresh coal. Waste heat will do it when vaporising in a vacuum.

Lectures.—Mr. G. S. Ram, electrical engineer to the Coventry Corporation, lectured on "Engineering Calculations and Measurements" to the members of the Coventry Technical Institute Engineering Society at their last meeting. Mr. Ram urged the importance of the adoption of the metric system, pointing out that it had already been adopted in electrical measurements. The lecture was illustrated with diagrams.

At the City of London College Science Society on Wednesday last week, Mr. W. Cozens-Cooke, A.M.I.E.E., read a paper on "Wireless Telegraphy." The President, Prof. Henry Adams, M.Inst.C.E., occupied the chair. The lecture was illustrated by experiments.

The Pimbley Economiser.—A novel form of economiser, known as the Pimbley, has been brought to our notice. The claims made for this economiser are that, owing to the more rapid movement of the water within it, the heat absorption capacity is very largely increased, and the recent experiments of Mr. Halliday are adduced in support of this contention. The next claim is that the high velocity of flow of the water prevents the adherence of scale, which must obviously travel foward to the boiler. To effect these ends the new economiser is made of pipes hung from top boxes, and free at their closed lower ends. Each pipe is really two pipes of segmental cross-section, the two pipes being joined at the bottom, but elsewhere separated by a flat space exposed to the flue gases. The pipes are short, and are scraped externally by scrapers worked by rods, not by chains. Being so short, the economiser can be placed in situations where longer pipes are inadmissible. There is no reason, however, why ordinary economisers should not have quite as rapid a flow in their pipes as this new economiser, if such rapid flow is desired. The claim for non-incrustation, even with a very impure water, is one which time alone can prove or disprove. We must confess to a strong feeling of doubt in respect to non-circular pipes, as we feel that in time some boring out must be inevitable, and we doubt the desirableness of pipes other than circular for other reasons. Testimonials are produced, however, which declare that scale refuses to form inside a Pimbley pipe. But what if scale did form? How can the pipes be bored out—an operation so easy with circular pipes? We have placed the facts before our readers, and further information is to be had from the makers of the new economiser, Messrs. Jas. Carter & Sons, of Stalybridge, Cheshire. It would be interesting if a longer experience should prove that incrustation did not occur where flow was rapid. If there is any truth in this, why do the internal pipes of steam boilers—we mean the feed distribution pipes—become so choked?

The Army Reserves.—The staff of the Sunderland Electricity Works held a meeting last week, and resolved to contribute weekly to the Mayor's fund on a scale proportionate to the respective salaries of the members. We heartily commend their example to the notice of our readers.

The Electrical Engineers' Swiss Tour.—An exhibition of photographs, taken by members during the recent visit to Switzerland, is to be held in the library of the Institution from December 5th to 12th. It is intended to reproduce a selection of the photographs for presentation to the library, the president, and the secretary of the Institution, and to enable members to obtain copies of these albums and of such photographs as they prefer. Full particulars may be obtained from the secretary of the Photographic Committee, Mr. R. S. Erskine, 22, Stamford Road, Kensington, W. We look forward to an interesting collection of photographs, for those who were not armed with cameras formed but a very small proportion of the party.

The Manchester Society of Junior Electrical Engineers.—A general meeting of this Society was held at the Deansgate Hotel, Manchester, on Tuesday evening last. Mr. W. W. Haldane Gee presided. A paper was read by Mr. S. Payne on "Condensers and Condensing as Applied to Electric Light Stations," which proved to be very interesting, the subject being afterwards freely discussed. The next meeting of the Society will be held on Tuesday, November 28th, when a paper will be read by Mr. J. H. Henderson on "Aluminium: its Treatment and Use as Applied to Electrical Engineering."

Appointments Vacant—The Devonport and District Tramway Company is in want of a tramways clerk of works.

The Watford Council wants an assistant engineer and other members of staff for the electricity works. For particulars of these appointments see our "Official Notices" this week.

The St. John Del Rey Mining Company, Limited, want a second electrical engineer for their mines in Brazil, for a four years' engagement, at £300. See "Official Notices" this week.

Institution of Electrical Engineers' Annual Dinner.—We learn from the secretary that the annual dinner of the Institution of Electrical Engineers will be held in the Grand Hall of the Hotel Cecil on Wednesday, December 6th.

A Double Conduit for Street Railways.—A difficult piece of track conversion is being carried on in New York, where, according to the *Scientific American*, both the Metropolitan Street Railway Company and the Third Avenue Railway Company possess the right of way through the same street. To operate the latter company's line by independent power system required a separate pair of power rails in separate conduits. The Metropolitan conduit had already been installed for a year and a half, so the Third Avenue Company is pushing the present conduit over to one side to give room for the other conduit beside it, between the two rails of the track. The difficulties are numerous in view of the fact that the track is kept constantly in service for the Amsterdam Avenue Cars, so that the men have to work alongside rails which are constantly charged. The pavement is first removed and the concrete foundation and conduit wall are broken up and removed from around the yokes and conductor rail. The track is shored up to carry the cars which are constantly running over it. Temporary wooden yokes are inserted to maintain the gauge of the track, and the old yokes are loosened and pushed to one side, carrying with them the old slot rails, insulators and conductor rails. The conductor rails are then removed in single lengths and the free ends are fitted with slippers to prevent the shoes on the ploughs from being carried away. The old yokes are promptly removed and replaced by new ones fitted for the two conduits, which are symmetrically placed between the track rails. While each company will have its own source of power, both will use the same rails.

Fire Tests on Wood.—A recent report of the British Fire Prevention Committee gives particulars of a fire test made upon "non-flammable" wood by the British Non-Flammable Wood Company, Limited, of London. The object of test was to record the effect of fire upon "non-flammable" wood (yellow pine), particularly to ascertain if boards of non-flammable wood sustain or spread flame *when in contact with fire*. The procedure of the test was to be as follows:—(*First stage*)—The application of flame for 5 minutes from one side at a temperature of about 500° F. (*Second stage*)—The application of flame for 10 minutes from the same side, and at approximately the same spot, at a temperature of about 750° F. (*Third stage*)—The application of flame for 15 minutes from the same side, at a second spot, and at a temperature of about 900° F. The three stages of the test were to follow at the shortest possible intervals. One-inch yellow pine boards were to be used in the form of a partition. The result of the tests was as follows:—No incandescence or spread of flame was observed, nor did the material, as far as could be seen, contribute in any way to the spread of flame. The surface of the boards was charred. Flame was applied at materially higher temperatures than those specified in the "object of the test." The temperature rose in the first stage to about 1,000° F.; in the second stage to about 1,150° F.; and in the third stage to about 1,300° F.

NEW COMPANIES REGISTERED.

Fladbury Electric Light and Power Company, Limited (63,942.)—This company was registered on October 25th, with a capital of £2,000 in £1 shares, to carry on at Fladbury or elsewhere in England the business of electric lighting, and to produce and supply electricity or electrical current and force, light, heat, or motive power, and telegraphic, telephonic, or other means of communication or locomotion. The first subscribers (each with one share) are:—L. Harold Elkington, Manor House, Fladbury, gentleman; Stephen H. Deakin, White House, Fladbury, merchant; George T. Stephens, Fladbury, miller; James W. Wagstaff, Fladbury, gentleman; A. L. Stephens, Charlton, near Pershore, miller; Lewis H. Helley, 3, Percival Road, Edgbaston, Birmingham; chartered accountant; and Edward R. P. Vradley, Elmdon, Sandford Road, Moseley, Birmingham, accountant's cashier. The number of directors is not to be more than five; the first are Stephen H. Deakin (chairman), Leigh H. Elkington, George T. Stephens, and William Wagstaff; remuneration as fixed by the company.

United States and Canadian Rhea, Rubber and Insulite Syndicate, Limited (63,957).—This company was registered on October 26th, with a capital of £30,000 in £1 shares, to acquire from W. J. Cordner certain inventions relating to the manufacture of a composition from rhea fibre, applicable for electric insulation and other purposes, and to carry on the business of manufacturers, spinners, dyers, and merchants of rhea fibre, cotton, flax, hemp, jute, and other fibrous substances. The first subscribers (each with one share) are:—W. Brinder, 43, Appach Road, Brixton Hill, S.W., clerk; B. Blewitt, 22, Grove Road, Wanstead, clerk; O. H. Oliver, 2, Beresford Villas, Park Terrace, Southend, cashier; J. Feil, 21, Hayter Road, Brixton Hill, S.W., secretary; S. C. Whittle, 40, Carlingford Road, N., accountant; A. Lowey, 248, Thorold Road, Ilford, secretary; and F. E. Mardon, 24, Arlingford Road, Brixton, S.W., clerk. The number of directors is not to be less than two nor more than seven; the first are H. B. Burnell, W. J. Cordner, and J. Keefe; qualification, £100; remuneration, £100 each per annum (£150 for the chairman), and a share in the profits.

F. J. Jones & Co. (Chester), Limited (63,988).—This company was registered on October 28th, with a capital of £3,000 in £1 shares, to acquire and take over as a going concern the business of an electrical engineer and electrician now carried on by Frederick J. Jones at the Princess Street Electrical Works, in the City of Chester, to adopt an agreement with the said vendor, and to carry on the business of electricians, electrical and mechanical engineers, and suppliers of electricity, cycle, bicycle, tricycle, velocipede, motor, motor carriage and vehicle manufacturers and dealers, &c. The first subscribers (each with one share) are:—Robert J. Knowles, 61, Brief Street, Chester, grocer; Thomas C. Burrell, 115, Foregate Street, Chester, draper; Frederick J. Jones, 5, City Road, Chester, electrician; Mrs. Mary H. Jones, 5, City Road, Chester; Samuel Smith, 16, Nicholas Street, Chester, solicitor; Edward N. Humphreys, Old Bank Buildings, Chester, chartered accountant; Rhoades B. Humphreys, 5, Hamilton Street, Hoole, Chester, accountant; and William D. Shepherd, 115, Foregate Street, Chester, outfitter. The number of directors is not to be less than three nor more than seven: the first are F. J. Jones, Thomas Gaze, and Robert Knowles; qualification, £100.

Glacier Anti-Friction Metal Company, Limited (63,989.)—This company was registered on October 28th, with a capital of £2,500 in £1 shares, to carry on the business of iron-founders, electrical, consulting, and general engineers, metal workers, boiler makers, machinists, iron and steel converters, &c. The first subscribers (each with one share) are:—C. W. Findlay, 4, Upper Bedford Place, W.C., metal merchant; A. J. Baute, jun., 4, Upper Bedford Place, W.C., metal merchant; T. W. Davies, 4, Upper Bedford Place, W.C., slate dealer; W. A. Clegg, Sunnyside, Knight's Park, Kingston-on-Thames, merchant; E. Siluvary, 45, Woburn Place, W.C., merchant; L. Avon, 45, Woburn Place, W.C., bank clerk; and W. J. Gresham, 40, East India Dock Road, E., engineer. Table "A" mainly applies. Registered office, 91, Queen Victoria Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Miners' Lamp Electric Lighting Company, Limited (28,010).—This company's annual return was filed on September 27th, when 301 shares were taken up out of a capital of £3,000 in 600 shares of £5 each; 190 shares are considered as fully paid, and the full amount has been called upon each of the remaining 111. £550 has been received, leaving £5 unpaid.

Exchange Telegraph Company, Limited (6,152 C).—This company's annual return was filed on August 23rd, when 8,125 "A" and 16,200 "B" shares were taken up out of a capital of £246,250 in 8,125 "A" and 16,500 "B" shares of £10 each. £8 is considered as paid on each of 2,125 "A" and £1 on each of 16,200 "B" shares (total, £279,000). £9 per share has been called up on £6,000 "A," and £1 per share on 2,125 "A" shares, resulting in the receipt of £56,023. £102 remains unpaid, and £816 has been paid on 102 forfeited shares.

CITY NOTES.

Yarmouth Corporation Electricity Accounts.
Public lighting and private supply.

The works at Yarmouth are but small, and, to some extent, suffer from the common complaint of all electricity undertakings at seaside resorts, that the load curve is not exactly what the engineer would choose had he a say in plotting it. Blackpool is probably the most marked case of the kind, but naturally, all "season" resorts are affected in the same way, although not to the same degree. Although there is still a loss shown after meeting all charges, this has fallen from several hundred to only a little over £50. This shows that the financial position is rapidly being improved, and a feature is that half the increase in gross revenue is gross profit. The average price received per unit sold remains about the same, just under 5d., and this, we suppose, will not be altered until the turning point between profit-making and losing has been reached and passed.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£33,622	£35,723	£2,101
Number of units sold	190,000	243,669	53,669
Maximum load in KW.	213 KW.	267 KW.	54 KW.
Gross revenue	£4,015	£5,165	£1,150
Gross profit	£1,365	£1,959	£594
Average price per unit sold ...	4·91d.	4·93d.	·02d.

For the units turned out the capital is certainly moderate. The public lamps have been increased from 72 to 75, and the units taken are as follows :—

	Units generated.	Units public lamps.	Units private.	Total sold.	Units not accounted for.
1897 ...	271,420	69,240	120,760	190,000	7,660
1898 ...	333,731	78,500	165,169	243,669	9,622

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£3,885	4·91d.	£5,002	4·93d.	·02d.
Meter rents	130	·16d.	163	·16d.	·00d.
Supply of lamps ..	...	...	...	...	...
Sundry	...	...	...	...	...
Gross revenue	£4,015	5·07d.	£5,165	5·09d.	·02d.

The works' costs have fallen about an eighth of a penny, and the total costs nearly the fifth of a penny; the only items in which an increase is shown being "repairs" and "rent, rates, &c." Even at the enhanced figure of about ¼d. per unit, repairs are extremely moderate, and although the latter item has a great deal more than doubled, it is a matter over which the engineer is, as a rule, powerless.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£1,080	1·36d.	£1,311	1·29d.	−·07d.
Oil, waste, water, and engine room stores.	271	·34d.	318	·31d.	−·03d.
Salaries and wages incurred in generation and distribution.	576	·73d.	598	·59d.	−·14d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	105	·13d.	245	·24d.	+·11d.
Works' cost	£2,032	2·56d.	£2,472	2·43d.	−·13d.
Rents, rates and taxes ..	66	·08d.	169	·17d.	+·09d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	451	·57d.	435	·43d.	−·14d.
General establishment charges, stationery and printing, law charges and insurance	101	·13d.	130	·13d.	·00d.
Other expenses	...	...	...	...	...
Total costs ...	£2,650	3·34d.	£3,206	3·16d.	−·18d.

The gross profit being less than the sum required to meet interest and sinking fund payments was aided by £57 being charged to the rates. Interest absorbed about £80 and sinking fund about £130 more than the previous year, the exact figures being :—

Profit Statement.

	1897.	1898.
Interest on loans	£950	£1,029
Sinking fund for repayments	852	987
Net profit (being deficit charged to rates) ..	−437	−57
Gross profit	£1,365	£1,959

Monte Video Telephone Company.

Mr. F. W. Jones presided over the annual general meeting of the above company, held at Winchester House, E.C., on Thursday last week, and said that last year the chairman pointed out a steady improvement in the company's business, and now he had the pleasure of saying that the prosperity had continued. The returns from the manager in Monte Video showed that there was a continual increase in the number of subscribers, the total of such increase being 160 for the year, or 50 per cent. more than last year. The result of that was shown in the item "subscription sales, rentals, transfer fees, &c., £18,308 10s. 8d.," which was nearly £2,000, or 12 per cent., more than last year. While that result was satisfactory in itself, it was a still further satisfaction to find that the working expenses were only heavier by £240, in which fact was reflected the efforts of their manager in Monte Video to keep down working expenses. The chairman proceeded to deal with the various figures in the balance-sheet, and said that with the amount written off stock of materials, that item was now closely approximating its actual value, the obsolete material in stock being now carried as without value. The capital issued was rather more than last year, the further issue being the preference and ordinary shares given in exchange for the company's promissory notes, as provided for under the scheme for reduction of capital. It would be remembered that at the date of the last annual meeting, none of those notes had been sent in for exchange, but they had now been cancelled and disappeared from the balance-sheet, all of them having been sent in for exchange for shares, with the exception of two for small amounts which were included in the item of sundry creditors. These shares, they were advised, would rank for dividend from the respective dates of allotment. The capital outlay for the year had amounted to £2,248, or £600 more than last year, but a less amount than might have been expected considering the greater increase in the number of subscribers. He thought the figures showed that the undertaking was in a sound condition and that the business was progressive, but a telephone business like theirs entailed considerable capital expenditure. With that before them the board considered it only judicious to place to reserve a sum fully covering the monies expended out of revenue and charged to capital, and they accordingly decided to carry £2,500 to reserve. They recommended also the payment of a dividend of 5 per cent. on the preference shares and 2½ on the ordinary shares, leaving £2,258 to be carried forward. The chairman proceeded to explain the changes which had taken place on the board owing to the fact that large blocks of shares had changed hands. During the past winter he had visited the River Plate, and took the opportunity to spend some time in Monte Video in order to look into the affairs of the company there. He found the conduct of the business under the administration of Mr. A. B. Powers was highly to be commended. His report to the board on his return was that the business was well managed, and only needed reasonable provision for capital expenditure to insure its position and increase its value. He also confirmed opinions previously expressed as to the advisability of keeping in mind certain extensions and improvements which the circumstances of their business would not admit of being indefinitely postponed. They were (1) the ownership of the control of the camp lines which connected Monte Video with important towns within 100 miles; (2) metallic circuits for the Monte Video subscribers; and (3) improvement of the central office building to obtain more accommodation for themselves and additional revenue by letting off. These improvements made it necessary to have more capital, and the board were considering the practicability of making use of their powers to raise the necessary funds, and it was hoped that they would be able to make satisfactory arrangements.

Mr. Loch seconded the motion, and it was carried.

City and South London Railway Company.

On Tuesday Mr. C. G. Mott presided at a special general meeting of this company, held at 46, King William Street, E.C. He said he was sorry to trouble them to go to a meeting merely for a formal purpose, but unfortunately at the last half-yearly meeting they could not carry out the proposed conversion because the stock was not fully paid up at that time. It having now been paid up he moved :—"That the existing 22,500 ordinary shares, numbered 1 to 22,500, be converted into consolidated stock."

Mr. Tate seconded the motion, and it was carried unanimously.

Mr. Mott said it might interest them if he stated that the extension through to Moorgate Street was in a very forward state, and they hoped to be able to open it to the public very early in December—say, about five or six weeks time. They could not say exactly, but everything was very nearly completed. As to the extension to Clapham Common, the underground works were nearly finished; there were surface stations to be built, and it was hoped they would be ready for opening probably about March. The construction of the Islington extension was also proceeding rapidly.

A vote of thanks to the chairman closed the meeting.

Thames Ironworks, Shipbuilding, and Engineering Company, Limited.

The first ordinary general meeting of this company was held on Monday at the offices, Orchard Yard, Blackwall.

Mr. Arnold F. Hills, who presided, said that since the reconstruction in July the engineering works of Messrs. John Penn & Sons, at Greenwich, had been finally taken over, and the new boiler shops, machinery, and plant were now practically in working order. A complete system of electrical driving and lighting had been introduced, with the result that the new shops for engine and Belleville boiler work were probably the best of their kind in the United Kingdom. After giving the meeting some particulars of contracts which had been received from the Admiralty and other sources, Mr. Hills said that, taking a broad view of the whole situation, he could but congratulate the shareholders upon the steady development of the company's business during the past three months, and he hoped that the present prosperity might be continuously maintained and enlarged.

At a subsequent meeting a resolution was passed making formal alterations in some of the articles of association.

Eastern Extension, Australasia and China Telegraph Company, Limited.

The report for the half-year ended June 30th, states that the gross receipts amounted to £324,361, against £277,282. The working expenses, including £28,177 for maintenance of cables, absorb £107,266, against £102,873 for the corresponding period of 1898, leaving a balance of £217,095. From this is deducted income-tax, interest on debentures, debenture stock, and contribution to sinking fund, and £5,000 for the creation of a reserve fund in connection with the proposed removal of the head offices, leaving £175,799 as

the net profit for the half-year. Two quarterly interim dividends of 1½ per cent. each, amounting to £62,500, have been paid for the half-year, leaving £113,299, from which £100,000 had been transferred to the general reserve fund, and the balance of £13,299 is carried forward. Further cable renewals and extensions have been carried out during the half-year, and the cost, amounting to £68,901, has been charged against the reserve fund. With a view to providing an efficient alternative service between Australia and this country, the directors, in conjunction with the Eastern Telegraph Company, have submitted to the Governments of Australasia a proposal for extending the new Cape cable to Perth and Adelaide without any subsidy or guarantee, and at once reducing the tariff between Great Britain and Australia to 4s. per word, to be followed by further reductions on a sliding scale down to 2s. 6d. per word as the traffic responds to the reductions.

Prospectus.

Yesterday, Thursday, the list opened and closed for London, and to-day it closes for the country, for the issue of £70,000 5 per cent. cumulative preference shares in the Alliance Electrical Company, Limited. The share capital of this company (formerly Veritys' installation department) is £120,000, in 7,000 £10 preference shares and 5,000 £10 ordinary shares. The company was formed to take over the business of electric light wiring and installing, and also retailing electric light fittings, formerly carried on by Veritys, Limited, at 137, Regent Street, London, and at Birmingham and Manchester. This branch of Messrs. Veritys' business has been for some time carried on quite independently of the electrical manufacturing and wholesale supply of electrical apparatus to the trade conducted from 31, King Street, Covent Garden, London, and its separate branches. It was considered advisable to form a separate company to develop the business, and for trade reasons. The prospectus gives names of a few of the many eminent personages for whom the firm has executed installation work. The auditors certify that the profits on the business taken over have averaged £8,790 per annum for the past three years. The purchase price of the business and properties was £106,150, for which £56,150 in 5 per cent. preference capital, and the whole £50,000 ordinary capital, have been allotted, these terms reckoning from February 1st, 1899; but Messrs. Verity have agreed to take cash, with interest, at 5 per cent. per annum from that date, in lieu of their preference capital, in order to enable them to further extend their factories at Aston for the manufacture of larger electrical machinery. The chairman of the Alliance Company is Mr. George Verity; Mr. J. Elwin-Coles is the London manager; Mr. T. Ions the Birmingham manager; Mr. C. S. Northcote is the Manchester manager; while Mr. W. R. N. Grimley is the managing engineer. Mr. W. Nicholson, of 137, Regent Street, W., is the secretary.

Stock Exchange Notices.—The Stock Exchange Committee have appointed Tuesday, November 14th, a special settling day in United River Plate Telephone Company, Limited, 16,639 5 per cent. cumulative preference shares of £5 each, £3 10s. paid, Nos. 1 to 16,639, and ordered same to be quoted in the Official List.

Callender's Cable and Construction Company, Limited.—The directors have decided to pay an interim dividend on the original ordinary shares of 5s. per share, equal to 10 per cent. per annum.

Electrical Undertakings, Limited.—A meeting of this company was held at Winchester House on Friday last, for the purpose of passing certain resolutions, but our representative was refused admission.

Chelsea Electricity Supply Company.—Letters of allotment and regret for the issue of £50,000 4½ per cent. debenture stock have been posted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 28th, 1899, were £238 10s. 1d.; October 28th, 1898, £262 3s. 10d.; aggregate for half-year to date, £18,871 15s. 9d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 27th, 1899, were £2,905 13s. 5d.; corresponding period, 1898, £2,819 2s. 3d.; increase, £86 11s. 2d.

The City and South London Railway Company.—The receipts for the week ending October 30th, 1899, were £1,045; October 31st, 1898, £1,000; increase, £45. Total receipts for half-year, 1899, £17,278; total receipts corresponding period, 1898, £17,275; increase, £3. Miles open, 8½.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 27th, 1899, were as follows:—D. U. T. Co., horse cars, £880 19s. 9d.; ditto, electric cars, £2,641 2s. 0d.; D. S. D. Co., electric cars, £759 17s. 2d.; total, £3,767 18s. 11d.; corresponding week last year—D. U. T. Co., horse cars, £880 9s. 10d.; ditto, electric cars, £2,364 15s. 8d.; D. S. D. Co., electric cars, £849 19s. 4d.; total, £3,595 4s. 10d.; increase, £172 14s. 1d. Aggregate to date, £74,603 10s. 10d.; aggregate to date last year, £72,110 7s. 7d.; increase to date, £2,493 3s. 3d. Worked:—The mileage open is 37 miles electrically, 7 miles by horses, as against 13 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending October 22nd, 1899, were £609 October 26th, 1898, £248; Car miles run, 11,898; 1898, 3,601. Number of cars, 21; 1898, 10. Total receipts to date, from April 1st, 1899, £17,628; 1898, from June 29th, 1898, £4,694. The receipts for the week ending October 29th, 1899, were £664; November 2nd, 1898, £248; increase, £416. Car miles run, 12,010; 1898, 3,665. Number of cars, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £18,292; 1898, from June 29th, 1898, £4,942. Miles of track open, 12; 1898, 8½.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 29th, 1899, amounted to £1,630; corresponding week last year £1,407; increase, £223.

The South Staffordshire Tramways Company.—The receipts for week ending October 27th 1899, were £624 18s. 11d.; October 28th, 1898, £664 10s. 6d.; aggregate receipts for 43 weeks, £28,658 8s.; 1898, £27,224 3s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

The buoyant tendency, previously the feature of almost every market in the House, received a decided check on the alarming report of British reverses at Ladysmith. The gravity of the situation was quickly realised by operators, and the more speculative quotations rapidly shrank in the hands of nervous bulls and under the influence of bears all too ready to grasp the opportunity of netting a profit on the fall.

Electric specialities, however, remained remarkably firm and merely shed small fractions.

In the telegraph department Eastern Telegraphs Ordinary, with a stride of 4 points, have been a feature, purchases being numerous on the strength of the increased revenue that will accrue to the company's coffers as a result of the war. Anglo-Americans have received support from a good quarter, and again mark an advance. Current quotations for this stock are still well below the highest points touched this year, a fact worth the investor's attention. Reports are afloat that the company's receipts have been considerably larger than last year's takings, and optimists are looking for a dividend for the current year of anything between 20s. and 30s. per cent. on the "A" stock, as compared with 18s. per cent. for 1898. Should only 25s. per cent. be realised, a yield of 7 per cent. on present price basis will be forthcoming to holders of the Deferred stock. Eastern Extensions have lost the improvement gleaned during the previous week. Reuters have failed to register any improvement. Other telegraph descriptions are unaltered.

National Telephone issues have received a fillip, and show a small rise. Supply shares have fluttered, Notting Hill Electric Lighting, St. James's and Pall Mall Electric Ordinary, and Chelsea Electricity Supply securing rises of 10s. each. The recent issue of debenture stock by the last-named company was largely over applied for. St. James's New are 10s. better, and it will be remembered that it was pointed out in this column last week that these shares were a cheap purchase.

It is somewhat singular that, in a good market, Electric Constructions should be so much out of favour. It may be that the price is weak upon the fact that two or three hundred shares in a deceased account are hanging over the market, but these would be a mere bagatelle in ordinary times. The quotation, however, has again receded ¼. Callender's Cable Construction shed ¼, but Henley's Debenture have recovered a point.

In the traction list, Central London Ordinary, fully paid, have been in moderate request, and the price has improved a trifle. The date of the completion of the works is said in the Stock Exchange to be drawing near, and as that time approaches there is likely to be a little life infused into the shares. City and South London were not affected by the statements made by the chairman at Tuesday's meeting. The line ought to be paying handsomely in another 12 months' time if the company's extensions attract the traffic which it is hoped that they will. Waterloo and City remains stolidly a point or two above par. Metropolitan Districts have lost most of their late spring, and at 32 show a trifling decline on the week.

Anglo-Argentine Trams continue dull, and there are sellers at 4. Other foreign and provincial tramway shares exhibit strength, and Calcutta can be disposed of at 9, the medium price. Tramways Union at 1½ are quoted ex £7 return of capital and bonus, this, of course, making the price equal to 8½ before the distribution.

A Leeds reader asks us for the quotations of Hampstead Electric Ordinary and Preference. We have to inform him that the market will not make any price at all. At the time of the company's *début* there was a very nominal price quoted, but the prospectus met with no favour, and subsequent attempts on the part of outside brokers to sell the shares at an absurdly high price have not tended to encourage a buying spirit. Should any inquiries come into the market they will be duly noted in this column. We are afraid that it is not only our Leeds correspondent who wants a bid for these unsaleable shares.

Wireless Telegraphy shares are likely to make a move shortly, several operators of the company's instruments having been despatched to the theatre of war in the Transvaal. Globe Telegraph and Trust Preference are better; the official quotation of 15½—¾ would be more correct if it were marked 15⅝—¾, which is the market price.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 25th.	Closing Quotation, Oct. 31st.	Business done during week ended Oct. 31st, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	64 — 67	65 — 68	67	65½
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114½—115½	116½—117½	117½	115½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	16 — 16½	16½ — 17	16 15/16	16 5/16
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅝	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2½ — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	180 —190	180 —190	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	103 —105	105½	103⅜
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	¼ — ½	¼ — ½	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20 xd	...	...
12,931	Direct Spanish Telegraph	£	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	3½ %	11⅜ — 12¼	11⅜ — 12¼	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	152 —157	156 —161	159½	153½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	101	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —123	117 —122 xd	119	118
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½ — 15	15 — 15½	15⅝	14⅜
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	118 —123	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —106%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11 — 11½	11 — 11½xd	11⅝	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15¼ — 15¾	15½ — 16 xd	15⅝	15½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	29 — 31	30 — 31	29¾	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	48 — 52 xd	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼ — ½	¼ — ½xd	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾ — 1	¾ — 1 xd	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5¼	5⅛ — 5⅜	5⅛	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13½ — 14½	14½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13½ — 14½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5½	5⅜	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	100 —102	100¼	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	½ %	½ %	½ %	⅜ — 1	⅜ — 1 xd	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	128 —133	128 —133	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜ — 5½	4⅜ — 5½	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½ — 1	½ — 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	½%	...	1⅜ — 1⅝	1⅜ — 1⅝	1 7/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½ — 10¾	10½ — 10¾	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½ — 9½	8½ — 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½ — 8½	7½ — 8½	8⅝	8⅜
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½ — 10½	9½ — 10½	9⅞	9¼
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6 15/16	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½ — 8½	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	110 —112	110 —112	111½	110⅝
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11⅜	11½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½ — 13½	12½ — 13½	13¼	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	10½ — 11	10 — 11	10⅝	10⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	81 — 84	111 — 114	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½ — 4	3½ — 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼ — 6¾	6¼ — 6¾	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15 1/16	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15½ — 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	14½ — 15½	15 — 16	15⅝	15
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3¾ — 4	3¾ — 4	3 13/16	3¾
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	14½ — 15½	14⅞	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 25th.	Closing Quotation Oct. 31st.	Business done during week ended Oct 31st, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	3¼	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16½— 17½	16½— 17½	17⅜	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13½— 14½	14	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6¾	6½— 6¾	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	1⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2¼— 2½	2 7/16	2⅜
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	105	104½
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13 — 14 xd	13½	13
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10¼— 10⅝	10⅝	10½
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5 1/16	5
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	...	...
630,000£	City and South London Railway	Stock	1 2/16 %	1 7/8 %	2⅛ %	63 — 66	63 — 66	63½	63
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6⅝	6¼— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3 13/16	3 2/16
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2½	2 — 2½	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2 — 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	¼ — ½	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	21½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8½— 8⅝	8⅞— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅜	13¼— 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	37¾	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	101	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 9½—10½.
Brompton and Kensington, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, ¼—¼.
Smithfield Market Electric, 1—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12¼—13¼; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 105—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18⅜.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 1st.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£19	£17	40s. inc.
a ,, ,, ... per ton	£27	£25	40s. inc.
a Bleaching powder .. .. per ton	£6 10	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£26	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a ,, White Sugar .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£37 10	£37 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a ,, Caustic (75/80 %) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a ,, Crystals .. .. .. per ton	£3	£3	..
a ,, Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b ,, Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 3" to 12") basis per lb.	8½d.	8½d.	..
c ,, Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c ,, Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g ,, Wire (basis price) .. per lb.	10½d.	10½d.	..
g ,, Sheet .. .. .. per ton	£88	£88	..
g ,, Rod .. .. .. per ton	£88	£88	..
m German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	6/-	1s. inc.
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/2½ to 4/5	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) per ton	69/6	69/-	6d. inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i ,, Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 12 6	£16 15	17/6 inc.
g ,, ,, Sheet .. .. per ton	£18 16	£18 10	6s. inc.
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 5	£8 17 6	7/6 inc.
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d ,, ,, ,, medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146	£149	£3 dec.
g ,, foil .. .. per lb.	1 6	1,9	3d. dec.
n ,, wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j ,, Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j ,, Hemp, 8 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j ,, ,, Russian, 10 lbs. per lb.	4½d.	4½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£13 10	£13 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.s.	£26 5	£26 10	5s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

PHYSICAL SOCIETY.

(Ordinary Meeting held October 27th.

Prof. W. E. Ayrton, F.R.S., Vice-President, in the chair.)

Dr. S. W. Richardson read a paper "On the Magnetic Properties of the Alloys of Iron and Aluminium."

Observations were made upon four alloys containing respectively 3·64, 5·44, 9·89, and 18·47 per cent. of aluminium. The alloys were used in the form of anchor rings, and were wound with primary and secondary coils separated by asbestos paper. The temperatures used ranged from −83° C. to 900° C. The low temperatures were produced by the rapid evaporation of ether surrounded either by ice and salt, or by carbon-dioxide snow. The high temperatures were obtained either electrically or by gas muffles. In both cases the actual temperatures were deduced from the resistance of the secondary, which was made of platinum wire, and wound next the metal. The author employed Maxwell's null method of measuring mutual induction, increasing the sensitiveness by the introduction of a secohmmeter, making about three revolutions per second. In order to test the accuracy of the method, some of the experiments were repeated with a ballistic galvanometer in the ordinary way, and the agreement obtained between the results in the two cases was well within the limits of experimental error. The chief conclusions to be drawn from the experiments may be summed up as follows:—(1) The alloys behave magnetically, as though they consisted of two distinct media superposed. (2) The general roundness of the curves, and their lack of abruptness near the critical point, seem to indicate that the alloys are heterogeneous in structure. (3) The permeability decreases with rise of temperature near the critical point, until a minimum value is reached, when further rise of temperature produces very slight diminution, if any, in the permeability. (4) The experiments suggest that the maximum value of the permeability for an alloy containing 10 per cent. of aluminium is reached at about 90° C. (5) An alloy containing 18·47 per cent. of aluminium has a critical point at about 25° C., and gives no indication of temperature hysteresis. This alloy probably has a maximum permeability much below −90° C. The author has found that at high temperatures there is a second maximum in the induction curve. This maximum becomes less and less noticeable as the field is increased.

The Secretary read a note from Prof. Barrett on the electric and magnetic properties of aluminium and other steels. The first part of the note dealt with the electrical conductivity of various alloys, and discussed the effect of composition and annealing upon the value of the conductivity. The second part of the note referred to magnetic effects. The most remarkable effect produced by aluminium on iron is the reduction of the hysteresis loss. The permeability of nickel steels is shown to be very much influenced by annealing. It is found that the addition of a small quantity of tungsten to iron hardly affects the maximum induction, yet increases the retentivity and coercive force. The experiments show that the best steel for making permanent magnets is one containing 7½ per cent. of tungsten. The magnetometric method was employed throughout.

Prof. S. P. Thompson drew attention to the wide range of temperature over which the author had conducted his experiments, and also to the small number of alloys used. He said a very much finer connection between the properties could be obtained from the examination of more alloys, and expressed his interest in the existence of the second maximum on the induction curve. He would like to know how the percentage composition of the alloys had been determined. Turning to Prof. Barrett's note, Prof. Thompson referred to the difference in the breadths of the hysteresis curves for aluminium and chromium alloys.

Mr. Appleyard asked for information upon the permanence of the curves.

Dr. Richardson, in replying, said the compositions were determined by analyses made after the experiments had been performed. It was proposed to carry on the research upon a series of aluminium alloys which he had obtained.

The Chairman expressed his special interest in the agreement which the author had obtained between the ballistic method and the null method of Maxwell, increased in sensitiveness by the secohmmeter.

Mr. Addenbrooke exhibited "A Model illustrating a number of the Actions of the Flow of an Electric Current."

The model consisted of a spiral of steel wire in the form of a closed circuit. Inside the spiral was placed a wire, which was supposed to be carrying the current, and which directed the motion of the spiral. A rotational movement given to one part of the spiral was transmitted by the wire and produced a rotational movement at another part of the spiral. The resiliency of the spring represents capacity and the torque electromotive force. Self-induction can be represented by weighting the spring.

Prof. Everett expressed his interest in the way that the correspondence between the propagation and the rotation agreed with that between the direction of a current and the direction of the magnetic force.

Prof. S. P. Thompson agreed that many analogies could be worked out by the model, but gave one or two examples to show that erroneous conclusions might be drawn by pushing the analogy too far.

Mr. W. Watson repeated some experiments with the Wehnelt interrupter devised by Prof. Decher.

The experiments showed in a clear and striking manner the fact that subsequent sparks tend to pass through the portion of air heated by the first one. In the first experiments motion of the heated air was caused by differences in density, and in the latter experiments by allowing the sparks to take place in a strong electro-magnetic field. The continuous rotation of the spark in a given field proves the unidirectional nature of the discharge.

In reply to Mr. Blakesley, Mr. Watson said he used the word "ionised" in his explanations to express simply the fact that the air had been rendered a conductor by the passage of the spark.

The Chairman referred to one of the first experiments performed. In this experiment the electrodes consisted of two copper wires in a vertical plane, slightly inclined to one another, and nearest together at their lowest points. On switching on the current the spark passed between the lowest points, but as the ionised air ascended, so did the most conducting path, and consequently the spark worked its way to the top of the electrodes. Here the heated air passed away, and the spark returned to the lowest point to rise again. The chairman thought that these effects might be due to the magnetic forces produced by the circuit itself. That similar effects in the arc light were due to this cause had been proved many years ago.

Mr. Watson repeated some of the experiments under new conditions, and proved that the explanation of the phenomena was not to be found in the tendency of the circuit to enlarge itself owing to magnetic forces.

Mr. Boys pointed out that the relation of the heating effect to the current, which was small in the arc light, was very large in the case of the spark discharges used, and therefore the movement of the spark in the latter case was practically determined by the heating effect in consequence of the relatively small importance of the electro-magnetic effect.

Prof. S. P. Thompson remarked that similar effects could be produced by an alternating current working an ordinary induction coil.

The Society then adjourned until November 10th, when the meeting will be held in the Central Technical College.

TRANSMISSION OF POWER BY GAS.

We referred some time ago to the question of the transmission of gas for the purpose of actuating gas engines at sub-stations in place of the transmission of high pressure current and the use of step-down transformation. At the time we gave some figures relative to the size of pipes necessary to carry gas for 1,000-H.P. engines, and pointed out that with producer gas—*gaz pauvre*—there was an enormous bulk of gas to be carried for very little energy as compared with coal gas or water gas. Should the system ever come into use, it would give a fillip to water gas, which contains little nitrogen as compared with air gas, for the area of pipes required would be only about a third of that necessary with air gas.

We are full believers in the future of the gas engine, but we must confess to doubts about the propriety of transferring gas in place of electricity. Before this time arrives, however, would it not be as well to give attention to the utilisation of the huge volumes of gas already made and sent to waste before shouting about making gas from coal and transferring it in pipes? The *American Electrician* states that present voltages are insufficient to enable waste heaps of culm to be turned into gas, and electricity produced and sent 100 miles. Surely this can be done in face of the fact that water-power has been utilised and transmitted as far. To transmit gas in pipes any distance would call for very large compressing plant, so that the pipe line might be kept small. The cost of this gas-compressing plant, and the proportion of gas it would use, together with possible relay compression *en route*, would be very considerable. Mr. George Westinghouse, who is now engaged in making gas engines, naturally has an interest in the gas producer, and he is of opinion that gas can be transferred more cheaply than electricity for driving electrical generators to replace rotary transformers.

Stated in brief, the question resolves itself into the choice, on the one hand, between gas-power driven generators, step-up transformation, high pressure line and step-down transformation, and on the other hand, gas compression, pipe line, and gas-driven dynamos at the point of power demand. Obviously much depends on conditions. As with electricity, the transmission line for gas can only be brought low in cost by means of initial compression. A low pressure gas conduit is always too heavy for its internal pressure, so that by transmitting gas under pressure, a saving is made in material. Long pipe lines have been used for oil in America, with relay pumping stations, but the amount of energy to the cubic foot is vastly greater with liquid oil than with gas, of a specific gravity less than one seven-hundredth that of oil. Where natural gas escapes at high pressure in America, its transmission appears feasible, and it is a fact little known here that small motors, like steam engines, are sold in America simply to be run with natural gas by its intrinsic pressure, not by its use as an explosive, as in gas engines proper.

The gas engine has certain advantages over steam not often recognised. It is not so necessary to seek a water front for condensing purposes. The gas engine requires little water; a small bore hole will easily supply all the water needed in a station of many thousand horse-power.

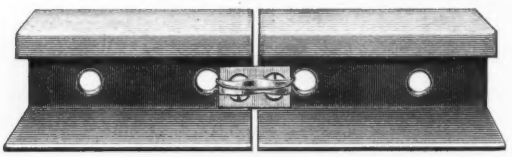
But gas engines are just as liable to cause vibration as are steam engines, and cannot thoughtlessly be brought into crowded neighbourhoods wherein a rotary converter could work without attracting notice. Why, too, should heat engines be brought to discharge bad gases into crowded cities when the cleaner electricity can be employed? To transmit gas is, we doubt not, perfectly feasible, but we think in the long run it will pay to use gas at the point of manufacture and transmit the power electrically at high pressure.

A NEW COPPER BOND.

A new type of bond, called the solid copper bond, has been designed by Harold P. Brown, and is described in the *Street Railway Journal* for October. It is not intended to take the place of his plastic bond for heavy duty, but it is intended for loads proportioned to its section. Its compact shape enables it to be sold at a low price.

The solid copper bond is made of a rectangular piece of rolled electric copper, 3 inches long, $\frac{1}{8}$ inch thick (or thicker), and $1\frac{1}{2}$ inches or more wide. A cup-shaped projection is pressed near each end so as to give a contact against rail web close to the end of each rail. Inside the cups is a piece of sheet steel supporting a pair of special steel springs; the steel is used to keep the springs from wearing into copper. These pieces are held together by a small iron strap until the bond is applied when the sharp web on the outside of the spring cuts it away and it enters the angle plate, thus aiding the conductance of the bond.

The entire bond is amalgamated to prevent rusting, and the contact surfaces are covered with the plastic alloy. The springs are proportioned to give a pressure of 1,000 lbs. per square inch when the angle plate is bolted up. The bond is always laid out to fit each particular rail and joint, and does not interfere with the mechanical fit of the angle plate. When in service the springs serve merely as



distance pieces so long as the joint is tight. If the nuts loosen or the plate wears, the springs still hold the bond in firm contact. Then tightening the track nuts also tightens the bond. The use of lock washers is advised on the track nuts to keep them fast. The springs then take up merely the wear of the plate.

To apply this bond it is only necessary to brighten the web of the rail beyond the end bolt hole with the usual hand-power grinder and emery wheel. The surfaces are then amalgamated by the Edison process and covered with a thin layer of plastic alloy. This unites with the amalgamation of the bond and maintains an electrical contact of low resistance which will not rust. The lubrication afforded by the plastic alloy permits the rails to move in any direction, without wearing away any metal of the bond.

The size of the copper will be varied to suit requirements of purchasers, up to the full area of the space between rail web and angle plate, and between end of bolt holes in rail. The manufacturer will not make a smaller size than No. 0000, since less than that amount of material will not give sufficient mechanical strength for durability.

The bond shown has a vertical cross-section of more than 0·218 square inch, while the section of a No. 0000 wire is but 0·166 square inch. The bond, therefore, has a conductance equal to one and three-tenths No. 0000 copper wires.

The depth of the special steel spring is varied to suit the clearance between rail and angle plate, and is always so proportioned, that the spring is perfectly flat when joint is tight. The steel is made for this purpose and will maintain its tension for years. On covered track in wet or alkaline soil where steel is apt to rust rapidly, both the springs and the sheet steel base, when desired, can be treated with a petroleum compound which will permanently protect them. This, however, will prevent the angle plate from taking any portion of the current through the bond contacts.

Amalgamated copper bonds of this type (but without the spring feature) have been in satisfactory service for several years. The springs are a safeguard against poor contacts when the joints loosen. As long as the joints are kept tight the bond will do its work. There is no bending or shearing strain on the copper since the bonds have sliding, lubricated contacts.

AMERICAN COMPETITION.

Considerable discussion is being evoked by the articles in *Engineering* on American competition. A Belgian considers that insufficient stress has been laid upon the very low rates of transportation which prevail in America, but he believes, if they would only set out to do it, that European roads could offer quite as cheap rates, owing to their generally better construction, and their large amount of high-class freight. American rates are very low, but American terminal charges are very high. The railroads only give station-to-station rates; they do not deliver. Yet, on the whole, their rates are low if long distances are to be traversed. Our own view of American competition is well known; it is, that American competition is rather absence of home production.

No one who knows anything of the prices charged for certain classes of American goods—prices which are now being frequently and considerably augmented—can doubt the fact that any men of capital could go into the business here and make nice fortunes. The marvel is that, with so much work looming in the near future, there should be so few manufacturers in this country for electric tramway equipment. Much of the present competition consists of the above kind. Much more is due to the fact that our own manufacturers are so very busy, and will not even quote a price for their own goods.

One correspondent of *Engineering* thinks that the existing American conditions are not stable, and considers that when the boom is over both here and in America, the big works there, which are based on a policy of maximum output, will find much difficulty in getting along. The federation of labour here has brought about, as a counterbalancing influence, the federation of capital, for labour had abused its privileges. In America, the federation of capital will probably produce a counterblast in the shape of a federation of labour, hitherto, perhaps, delayed by lack of homogeneity. Successful American competition has been due, as all of us know, to reducing men almost to the level of machines. The life of a machinist is one grinding monotony, and cannot even be tolerated at the present long American hours. Such workers, no matter how well paid, cannot ever remain good, intellectual citizens. They must either degenerate, or have greater leisure. America has trained her workers, it may be argued, to work, and we do not see why these men should not work, say, six hours a day, and still compete with men who loaf eight hours. Our own short hours have been abused by the class of men fostered by the Amalgamated Society of Engineers, and this evil influence, now extending over many years, has much to answer for in the reduced productive power of the country. The worthy Tom Mann, who did his share to stop the use of machinery, is at present writing against employers, and, like John Burns, calling for the American methods he has done so much to delay. For ourselves, we don't so much want American methods as a return to old time hard work and modern short hours.

Undoubtedly there is serious danger ahead for America in a rigid continuance of the system which has built up her competition, but America is still far from full, and can make risky experiments upon which other lands could not venture. For the moment Americans are naturally jubilant at the success of their goods in foreign countries, but we do not see that there is any special need to be alarmed. Americans would sell very little in England, or any part of Europe, if such countries could not afford to buy, and profit by the buying. Should American competition ruin Europe in the sense that some of the short-sighted American writers appear to look for as a glorious consummation of American genius, it would be but a poor look out for American business in the future. They would not export many tools to a bankrupt Europe out of pure love of export. American competition has done good to America. It has taught the thinking amongst them that it is not well to desire ill for your best customers.

France has not learned the lesson yet, and would gladly sink England below the sea, but Germans are beginning to see that, as a customer, England is better strong than weak, and even Russia values our markets. Foreign trade has made free traders of the Americans, who, only a few years ago, never tired of inveighing against the corruption of American politicians by the gold disseminated by the Cobden Club. What a poor opinion Americans must have held of their politicians at that time! We welcome American or any other competition when it is fair.

ENGINES WITH DIRECT CONNECTED DYNAMOS.

The views on the stresses in shafts, due to fly-wheel energy and load fluctuation that were lately advanced by us, have been again put forward by a correspondent in the *Engineer*, Mr. Chas. Day. Mr. Day finds himself unable to accept a claim made, we may say erroneously, by another correspondent, that a heavy fly-wheel will lessen the stress in a shaft. It will only lessen the stress on the engine side of the wheel, but it will increase the stresses on the generator side. We are glad to find so able and experienced an engineer as Mr. Day corroborating the views set out by ourselves in regard to the necessity of a good connection between the fly-wheel and the armature, whereby alone can stress fluctuations be dealt with directly from the fly-wheel without the stress passing through the fly-wheel. As Mr. Day remarks, the stresses in a traction station do not, as a rule, vary from nothing to a maximum. There is almost invariably some load upon the line when the maximum is suddenly brought on. It is, of course, a common occurrence for the load to drop from a maximum to nothing. This occurs every time the circuit breaker goes out, but the converse rarely, if ever, happens. When the circuit breaker is put in, the cars standing on a line are generally shut off at their switches, and do not all switch on again at once; and in this connection it must be remembered that a small fraction of time, say, a fourth or a tenth of a second between the switching on of cars is ample to warrant the load being called gradual. To put 10 cars into movement every second only means, with some engines, one car every stroke, and as each car goes in it renders the putting on of the next car a less proportion of the whole load. If the Glasgow affair has had no other use, it will have served to dispel many hazy ideas as to the supposed enormous stresses of traction work. It

has also pointed out the fact that American makers of big engines do not appear to yet dare speeds above 75 r.p.m., which does not, to say the least, point to much superiority over any English maker of big engines. It is curious that in large work Americans should have elected to run at such slow speeds, for in their smaller engines they are so particularly successful at high speeds. We do not quite agree with Mr. Day, that weight of fly-wheel can have little effect on the shaft stresses under variable load, for with a heavier wheel a sudden accession of load is taken on with less variation of angular velocity in a less space interval. With heavier wheels the retardation effect of an additional load is less, and this, says Mr. Day, helps the governing. It does, in a sense, but also it reduces the inertia effect of the inertia part of the fly-wheel governor. Looked at from any point of view, the direct connection of fly-wheel and dynamo is advantageous.

THE INSTALLATION OF STEAM BOILERS.

IX.

At one time considerable discussion took place as to the relative merits of the steam dome and the anti-priming pipe. That steam domes were often found plastered all over with mud is a fact that goes a long way to discount any special value that might be attached to them. But to-day considerations of strength demand their abolition, producing as they do a large area of shell exposed to steam pressure on both sides, and, therefore, under complex stresses.

It may, however, be fairly argued that the steam drum is an advantage. A steam drum may be large enough to contain a baffle plate to change the direction of flow of steam and distribute it all over the drum area. A steam drum may also be connected to the shell by a small block. Two drum connections are usually made to the shell. This is undesirable. One rigid connection should be employed, the other end of the drum being only supported upon the shell but not attached rigidly. A thin plate support placed across the line of expansion will admit of the necessary movement, and prevent all stress on the shell or drum itself. The anti-priming pipe is, however, now usually considered sufficient. It is a cast-iron pipe extending each way from the steam valve and block, into which its top branch projects a neat fit. The top and sides of the pipe are slotted with numerous holes, the joint area of which should not exceed by more than 25 per cent. the area of the steam outlet valve. The pipe is about 8 feet long and may be 6 inches inside diameter, with one or two holes for drainage. It is carried by lugs at each end, with bolts to sling it from angle brackets double-riveted to the crown of the boiler shell, and the top of the pipe should come near the top of the boiler, but not closer than an inch to any plate. The object of the pipe is to collect steam from a considerable length of the boiler, whereby a rush of steam, which would possibly carry a lot of entrained water, is prevented. Hence the rule that the perforations should not exceed by more than 25 per cent. the steam outlet area. With too large an area, one end of the pipe might carry a big rush of steam and cause priming. It was to the vortex action of gusts of steam that steam domes owed the muddy contents which proved their failure.

The blow-out tap is usually placed about a foot in front of the front end plate, the centre of the blow out block being about 15 inches further back. As there are considerable stresses brought upon the tap, it is attached to the boiler block by a cast-steel elbow pipe, tapering from 6 inches inside diameter at the mounting block to 2½ inches at the top end. Beyond the tap the connection is copper, usually a bend to the waste main, but better a straight piece placed between the tap and the independent cast-iron waste-pipe leading to the separate blow-out box. The separate blow-out box may be 10 feet in front of the boiler, or even buried under the coal in the bunker. It may be 3 feet deep and 2½ feet square, and should have a waste pipe to the final drain, and a free outlet to the air to prevent internal pressure, and its cover should be secured so as not to lift with pressure.

The water-gauge taps should have waste pipes connected to the blow-out wastes beyond the taps in preference to a free discharge to the hearth pit. One of the most troublesome of fittings is the water-gauge. Glass is so soluble at high pressures that water-gauge glass tubes easily break, and require very careful fixing with cone washers. These are held against the tube by the steam itself. The tubes must be free, and ought to be capable of being turned round in their place, even when at work. The frequency of breakage necessitates automatic shut-off valves. It is claimed that a reliable automatic shut-off can only be obtained by means of a back tube.

There are numerous patterns of water-gauge taps with automatic action, and intending users should carefully investigate before purchase. One thing is essential: Water-gauge taps must be large and heavy, or they speedily leak and become dirty and unsightly. Their handles should be as big as can be grasped, and the whole fitting large in proportion, and they are to be bolted to facings riveted to the front end plate. The front end plate connection of the steam gauge syphon must also be large and heavy, and the dial of the gauge at least 10 inches diameter.

In the best practice the manhole mounting is surrounded by a chequer plate platform on a frame, with two or three steps down to the cover of the side flues. Over the centre of the manhole is carried right across the battery of boilers a girder of rolled steel of I section, on which runs a light trolley, with hook and left and right screw turn-buckle, to lift the manhole cover by the eye bolt, which is screwed into all these manhole covers. This facilitates removal of the cover, which is readily run aside, free of any risk or injury to its joint facing.

As the damper ropes are sometimes considered an impediment, some engineers made the side-flue dampers to swivel. When so arranged there is a short arm on the top spindle, and this arm is sunk below the surface of the covering flags, and actuated by a rod which is laid in a channel in the brickwork under the flags, and worked by a hand wheel on the front glazed brick cross wall with a gun-metal square threaded bush. The arrangement may be made very neat.

The furnace doors are usually of cast-iron, with an air grid of large area closed by a grid plate worked by a single turn of a cross bar handle placed in the centre of the door. The grids project on the face of the door, and are together with the encircling rim machined and polished. The doors are hinged to a sheet-iron or steel plate bolted to three angle brackets which are double riveted upon the furnace plate, one at the crown and one at each side. The edge of this flat plate is concealed by a flat moulding ring of cast bronze bearing the maker's name, but in no way covering the rivets of the furnace. The grate surface is placed as low as possible consistent with maintaining practically the full diameter of the furnace tube at the grate surface. Inside the plate is usually an arch of cast-iron surrounding the door and carrying the fireclay liner to protect the furnace front. A firebrick arch should protect from the dead plate right round the crown of the furnace above the dead plate. The door grids should afford an area of about 60 square inches, or 1½ inches per square foot of grate area for air admission after firing, when bituminous coal is used. Inside the door a second plate is fixed, about 3 inches from the door body, and perforated full of holes, in order to divide the inflowing air into small streams.

Grates are usually made 6 feet in length, in two bars of 3 feet each, which extend from the dead plate to the bridge. The dead plate extends about 1 foot to 15 inches from the front end plate, and the back end of the grate is set lower than the front, from 3 to 6 inches according to opinior, sloping down to the bridge end.

Bridges are often of solid firebrick, in which case they ought to have only the round edged blocks we have already named against the plate. But they are better of cast-iron, neatly fitted and bolted to the back end bearer brackets of the grate. Indeed, the bridge casting may form the bar support. The angle brackets are like all other little brackets, double riveted to the furnace sides, and the grate cross bearers are rigidly bolted to these brackets, thereby preventing possible detrusive action by the weight of bars and fuel. The cast-iron bridge then carries a firebrick top wall, and should have a door in the ash pit communicating with the flue behind the bridge for cleaning purposes.

Where scum troughs are used, they discharge by the tap

already described upon the opposite side of the front end plate from the feed valve, by a straight down pipe through the cast-iron hearth plates into the same waste pipe as the bottom blow-out or sludge tap. This vertical waste pipe passes through the hearth plate by a hole of 1 inch greater diameter than the outside of the pipe, and the space is concealed by a brass collar on the pipe simply resting flat on the hearth plate. In the hearth pit the waste pipe is joined by a copper piece to the waste pipe of the sludge tap, or direct to the blow-out box.

The dead weight safety valve is always placed near the front of the boiler, and it should have upon it a lever, with a box end so projecting and placed as to be capable of receiving the end of a special bar, by which the fireman can

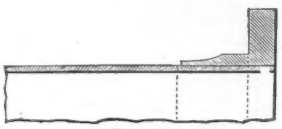


Fig. 25.

reach from the firing floor and lift the weight at least once daily to test the valve. For a similar purpose a platform of chequer plates extends right across all of a row of boilers at the back of the Hopkinson valves, in order to enable the fireman or other appointed assistant to lift the levers and blow the valves daily. If arranged that the l.w. safety valve comes next to the steam junction valve, this same platform serves for both the safety valve and for access to the stop valve. Blow-off waste pipes are often attached to the safety valves to carry off the steam. It is better not to fit these pipes, for with a good fireman safety valves should rarely act—hence the importance of a daily test to prove their freedom ; but drip pipes must be provided to keep moisture off the boiler. These and the drain pipes of the steam valves require to be brought down direct by a curved pipe just over the crown covering into common waste pipes, the pressure drains being carried to steam traps discharging to the feed pump supply. These waste pipes should be carried just over the side flues, out of the way of the pathway. In some cases a platform of cast-iron diamond grid plate extends over the whole of a set of boilers, above their crowns, and free of any connection with the fittings. Such floors afford very convenient access all over the boilers to every mounting, and are very good if carefully attended to as to cleaning beneath.

It will have been observed that freedom from binding has throughout been sought in all arrangements, and where pipes leave a boiler they have been provided with means of accommodating themselves to slight movements without risk of fracture. No pipe is more important than the steam pipe. In a battery of boilers each boiler discharges to a common steam main. It is not a good practice to take a straight pipe directly from the steam outlet valve to the steam main against the back wall. It is better practice to carry the main above the boilers and connect to it by a bend from the steam valve. But it is much better to carry the boiler branch upwards by a bend from the steam valve and then some 10 to 20 feet back to the steam main along the back wall of the house or slung from the roof. This provides length of pipe to ease any movement stresses. Where space will not afford liberal treatment it is good practice to interpose a long U bend of copper between the boiler and the steam main. These are superior to telescope pipes, which are apt to leak and give trouble, and expansion discs also are not satisfactory owing to the enormous abutment resistances they require but rarely get. Boiler branch pipes are, perhaps, best slung from above. Main pipes near walls may be carried on brackets with rollers or slung from wall brackets above. There is a tendency for steam pipes to commence vibrating, an action very injurious to the joints. This occurs with pipes near an engine. The engine starts the vibration. For such it is better to rest the pipes on solid brackets without friction rollers, and in such case a wearing piece must be rigidly attached to the pipe where it rests on the brackets. These wearing pieces save the pipe being rubbed through. This system allows every freedom for expansion, yet checks vibration as by a brake. Indeed, it is permissible to actually clip a pipe to the extent of stopping vibration if the clip bolt is small and the clip light, so that expansive movements may not be unduly resisted. Needless to say, steam pipes are now made of lap-welded steel or iron for high pressures. They are screwed into steel flanges with a fine thread (Whitworth gas, not the American coarse pipe thread), and expanded tight with faced flanges. If copper is used, the flanges should be of gun-metal, and the pipes solid drawn, not brazed, and for high pressure, and anything over 8 inches, they may profitably be wire wound or hooped at short distances. The flange of a copper pipe should taper down to a feather edge when it meets the body of the pipe, as otherwise the pipe is very apt to fail at the flange where the sudden difference of rigidity occurs (fig. 25).

If a boiler be made and set in accordance with the general and detailed directions of these articles, it will be accepted by the best boiler insurance companies as a first class boiler. An inspection of such a boiler will show that no part of the interior is concealed from view, that the whole of the interior of the tubes can be seen, and the whole exterior of the shell can be actually seen, there being no contacts except along a line. All this can be done easily. Perhaps we ought to except the boiler crown. This is usually covered by a composition which is blown off if there is the slightest leak at a seam. But firebrick air-space blocks are now made to cover boilers, and they have little projections to touch the boiler. These fit close, and can be lifted off and replaced at will for inspection. The soft compositions are, however, also very good and safe, as they show at once if a leak commences.

A first-class modern-made boiler is really as accurate a piece of work as an engine, and steam users are advised ever to use and consider them as such. Their shells and furnaces are truly circular, their rivet seams are all machine made, and the best makers aim to close every rivet mechanically if the mounting blocks are attached to their respective plates before the plates are put together, and by similarly riveting up gussets in proper sequence.

A boiler thus made does not really require to be tested, but it is usual to test it to the extent of 75 or 80 per cent. beyond the intended working pressure. Formerly double the working pressure was allowed, but it is very doubtful if more than 50 per cent. excess should be put upon any boiler. Such a margin is enough to show the yield of the end plates, but larger pressures do no good, and tell nothing of the bursting pressure. A boiler made by modern methods can be made good and safe by proper selection of material, and attention to accuracy of workmanship. Some of the demands made in the foregoing articles may appear exacting, yet they are practically as easy to carry out as the shoddy work which is too frequently allowed by boiler-makers to spoil the best of their work. This is especially the case in details of finish, such as flue entrances, hearth pit covers, damper details, and other items, which are as cheaply done well as ill. In a finished boiler house it ought to be easy to get about over the whole of the boilers, to reach each safety valve for testing, and get to each steam valve without treading on the covering composition or stooping beneath steam pipes and small waste pipes, or brushing against damper chains or ropes. It is just in such items as these that many of the contractors for electrical work to-day display their ignorance of good practice by reverting to systems and methods which good practice has rejected these last 30 years.

UNITS OF MEASUREMENT.

By W. MOON.

All who try to master the C.G.S. system of units experience a difficulty in understanding them owing to the smallness of most of the units. The introduction of the practical electrical units has, in a way, severed their connection from the fundamental units, and made them almost as useless as if they were not founded upon an absolute system at all. It is very unlikely that practical men will ever adopt the C.G.S. system.

The first essential in founding a physical set of units should have been to select as fundamental units those measurements of mass and length most commonly used, so that the value of the derived units could be more easily understood. And the unit of time should then have been selected to make the mechanical units of about the value of those in general use.

Of all the metrical measures the litre and the kilogramme are the most commonly used and understood. And as no system of units should depart from the rule that unit capacity contains unit weight of water, the kilogramme as unit of mass and the decimetre as unit of length are certainly the two fundamental units of length and mass upon which all physical units should be founded.

Hitherto the second, which is an awkward fraction of the day, has been taken as the unit of time. There is, however, a growing tendency on the Continent to introduce decimal time, and this will no doubt be done ultimately for all purposes. For this reason, if for no other, a decimal time should be used in physical units. A decimal part of the fourth of the day would be better than that of the whole of the day; since the unit of length is based on a decimal part of a quadrant of the earth, and it is advisable to have time and longitude agree. All trigonometrical functions are, moreover, nearly related to the quadrant than to the circumference, and it is the quadrant that is divided into decimal parts "grades" and not the circumference.

The $\frac{1}{10}$th of a day = 86 minutes, and the $\frac{1}{10000}$th of a day = 21·6 seconds, would be as convenient, or more convenient, for ordinary use than the hour and the minute; while for physical purposes the $\frac{1}{10000000}$th of a day = ·0216 seconds could be taken as unit of time.

This unit of time with the decimetre as unit of length gives $G = ·04577$ and $G^{-1} = 21·85$. And the weight of 21·85 kilogrammes is certainly a more rational unit of force than the dyne of about a millionth the weight of a kilogramme. The unit of power with these units of time and length is a kilowatt to within 1 per cent.

The number of C.G.S. units in the proposed mechanical units is as follows:—

	Symbol.	Dimensions.	No. of C.G.S. units in proposed units.
Length	l	L	10
Area	A	L^2	100
Mass	M	L^3	1,000
Velocity	V	$L T^{-1}$	463
Acceleration ...	G	$L T^{-2}$	$21·43 \times 10^3$ G = ·04577
Force	F	$L^4 T^{-2}$	$21·43 \times 10^6$ weight of 21·85 kg.
Work	W	$L^5 T^{-2}$	$214·3 \times 10^7$ = 21·43 joules.
Kinetic energy ...			
Moment of couple			
Power	P	$L^5 T^{-3}$	$9·923 \times 10^9$ = kilowatt nearly.
Pressure and stress per unit surface		$L^2 T^{-2}$	$214·3 \times 10^3$ = 3·18 lbs. per sq. in.
Momentum ...		$L^4 T^{-1}$	463×10^3
Conductivity of heat		$L^2 T^{-1}$	$4·63 \times 10^3$ = power per unit area.
Radiation of heat ...		$L T^{-1}$	463 = power per unit area.
Caloric		L^3	10^3 = 4,250 joules.

The giving of the various units names is certainly useful as regards those most frequently used, but has led to some confusion with those less frequently employed, and the better plan seems to be to speak of the latter, as so many units of work or of pressure, for instance.

In dealing with very large or very small quantities the usual prefixes expressing multiples of the units could be used without giving the unit a name. Thus a very small force could be spoken of as so many microunits of force.

It is a great advantage to express different values in one uniform set of units. Thus the proposed unit of velocity = 4·63 metres per second, so that the average rate of walking would be ½ a proposed unit, the velocity of a train, say, 7 units, the velocity of sound 74 units, the velocity of rotation of the earth at the equator 100 units, and the velocity of light, $64·885 \times 10^6$ units.

The introduction of decimal time would make it needless to express velocities in any other form than as a ratio of the units of length and time.

The unit of force could, of course, be used for either a stress or compression. While the unit of pressure, that is, unit force per unit surface could replace the arbitrary scales of inches now used in pressure gauges and barometers.

Allowing for the error in the B.A. ohm, Joule's equivalent in the proposed units would be about 198 for a kilogramme degree Centigrade.

Many advantages would result from doing away with this equivalent as first proposed by Sir William Preece to the B.A. in 1888. The heat of combustion would then be in units of energy directly, as also the latent heats of fusion. For if the degree of temperature is taken as unit of energy in unit volume of water, the latent heat of water would be 15,700, and of steam 105,000 proposed units, and the heat of combustion of coal $1·6 \times 10^6$ units.

Moreover, with such a scale of temperature, the thermal conduction or radiation per unit surface would be in units of power per unit surface.

The work of Tyndall and others has shown how the intensity of illumination, which has hitherto been given in arbitrary units, could be expressed in power expended in light rays per unit surface. And the power of a source of light in power radiated in light.

The efficiency of any source of light would then be

$$\text{efficiency} = \frac{\text{power in light}}{\text{total power expended}}.$$

Although light could not conveniently in practice be measured in this way, standard flames like the pentane lamp could be standardised in absolute units for practical use.

A thermometer graded in the proposed degrees might, for ordinary purposes be graded in 10^3 degrees starting from the absolute zero of temperature. The scale for most thermometers would extend from 50,000 to 75,000.

Proposed degrees, Centigrade, l.	Centigrade, ths.	Fahr., ths.	
40,000	−70	...	
46,000	−40	−40	Mercury freezes.
50,000	−20	...	
54,000	0	32	
56,000	...	...	Mean temperature, London.
56·970	15	60	
59,940	30	86	
61,250	36·6	98	Blood heat.
73,800	100	212	
75,000	106	...	
84,000	150	311	Steam pressure, 80 lbs.
94,000	200	392	" " 250 "
99,600	230	447	Tin melts.
104,000	250	...	Temperature of fire-box of locomotive.
158,200	526	Just visible.	
252,000	1,000	Silver melts.	
450,000	2,000	...	Platinum melts.

Such a method as this of grading thermometers would keep constantly in view the great waste in the transformation of the energy of coal into power and light.

The doing away with Joule's equivalent also simplifies the calculation of the E.M.F. of chemical combinations:—

Electro-chemical equivalent, copper = 65×10^{-6},
" " " zinc = 67×10^{-6},
Heat of combustion, copper = $·118 \times 10^6$,
" " zinc = $·2525 \times 10^6$.

$$\text{E.M.F.} = \frac{w}{q} = w \text{ . equivalent.}$$

E.M.F., zinc = $67 \times ·2525 = 17$ units,
" copper = $65 \times ·118 = 7·67$ "
Their difference = 9·33 units, say E.M.F. of Daniell cell.

(To be continued.)

THE SERVICE PERFORMANCE OF RAILWAY MOTORS.*

By W. B. POTTER.

The conditions imposed in railway service are so intermittent and varied, that it is not possible to establish a standard factory test that will meet all the requirements of actual practice. The General Electric Company has therefore adopted, as representing extreme conditions, an arbitrary standard, based on temperature rise of the motor of 75° C. in one hour, the temperature of the surrounding air being assumed at 25° C. The horse-power rating obtained on this

* *Street Railway Journal.*

basis represents only one hour's continuous run, and the temperature of the motor will rise to an injurious point if it is operated for an extended time at the rated output.

While a railway motor cannot be operated continuously at the rated horse-power without injurious heating, this output can be exceeded for short periods of time, as in rapidly accelerating a car or climbing short heavy grades, but for ordinary service the average horse-power required of a motor throughout the day should not be greater than 30 per cent. of its horse-power, rated on the hourly basis, which will give a temperature rise of about 60° C.

These figures are based on a line potential of 500 volts, and the average rating of the motor may be increased approximately as the voltage is increased. For example, if a motor wound for 500 volts be operated on a potential of 550 volts, the average output may be increased about 10 per cent.

When electric brakes are proposed, a motor of greater capacity must be used, since the heating of the motor is increased from 20 per cent. to 25 per cent. by the use of electric brakes, this extra heating depending on different conditions of service. The minimum increase of 20 per cent. represents a service containing few grades and stops, and the maximum of 25 per cent. should be allowed on hilly roads with frequent stops, where the electric brake will be in use a large part of the time.

Horse-power of Motors.

The total horse-power (rated on the hour basis) of an equipment for ordinary city and interurban service may be determined approximately by the following general formulæ. The ton in all cases is taken as 2,000 lbs.

$$\text{Horse-power} = \frac{(\text{Total wt. in tons}) \times (\text{Maximum speed in m.p.h. on level})}{5}$$

If electric brakes are to be used, the formula should be as follows:—

$$\text{Horse-power} = \frac{(\text{Total wt. in tons}) \times (\text{Maximum speed in m.p.h. on level})}{4}$$

If the maximum speed is not known, it can be taken as being twice the schedule speed, since this ratio is usually found in practice.

As an example, assume a 20-ton car, with a maximum speed of 50 miles per hour, the line potential being 500 volts, then

$$\frac{20 \times 50}{5} = 200 \text{ H.P., or four 50-H.P. motors.}$$

If the line potential were increased to 600 volts, electric brakes could be used with these same motors, the gear ratio being changed to give the same speed as before.

As another example, consider an ordinary street car weighing, equipped and loaded, 11 tons, the maximum speed being about 25 miles, then

$$\frac{11 \times 25}{5} = 55 \text{ H.P., or two 30-H.P. motors.}$$

If electric brakes were to be used, then

$$\frac{11 \times 25}{4} = 69 \text{ H.P., or two 35-H.P. motors.}$$

The motor capacity required for any given service is so largely affected by the condition of track, grades, &c., that these rules should be cautiously applied, as they are simply a guide to the selection of a motor equipment, and indicate the *minimum capacity* under ordinary conditions.

The schedule speed, or speed of the entire run, including stops, is ordinarily about one-half of the maximum speed on a level track; but where stops are frequent, this ratio becomes less. In suburban service this figure may be exceeded, since the relation between the two speeds is governed by the number of stops per mile the cars are required to make, and the fewer the number the more nearly the schedule speed will approach the maximum speed. For example, if a certain equipment can make a maximum speed on a level of about 25 miles per hour, then the limit of the schedule speed with seven stops per mile will be about 10 miles to 12 miles per hour, while the same equipment, with but two stops per mile, could make a schedule speed of between 15 miles and 18 miles per hour. High schedule speeds with frequent stops require equipments with large motor capacity, and problems of this kind should always be treated as special.

Tractive Effort.

The tractive effort required to move a car or train is dependent on the rate of acceleration, grade and car friction, air resistance being included in the latter. In railway practice acceleration is conveniently expressed in miles an hour per second, that is, an accelerating rate of 1 mile an hour per second means that the rate of speed is increasing 1 mile each second, and that in 20 seconds, for example, at this rate, the speed will be 20 miles an hour. One mile per hour per second is equivalent to 1·466 feet per sec.

Excluding car friction, a tractive effort of 92½ lbs. per ton (2,000 lbs.) will produce an acceleration of one mile an hour per second on a level track, and the rate of acceleration will vary in direct proportion to the amount of tractive effort used. On the ordinary street car the tractive effort during acceleration often rises to between 200 lbs. and 300 lbs. per ton. In elevated or suburban train service, the maximum tractive effort is generally from 100 lbs. to 150 lbs. per ton, while for heavy freight work, where slow speeds are used, it may not exceed 30 lbs. or 40 lbs.

Grades are commonly expressed in percentage of feet rise in a length of 100 feet, and the tractive effort required for a grade is the same percentage of the weight as the rise in feet is to a length of 100 feet. For instance, a 3 per cent. grade will require a tractive effort equal to 3 per cent. of 1 ton, or 60 lbs. per ton. To this figure must be added the tractive effort necessary to overcome the car friction, if the total tractive effort is required.

The tractive effort necessary to overcome the rolling friction of the rail and air resistance has been compiled from a number of tests, and the approximate amounts are given in the following table:—

Fifteen-ton car, up to 25 miles per hour, tractive effort equals 25 lbs. per ton.
Fifteen-ton car, up to 50 miles per hour, tractive effort equals 50 lbs. per ton.
Twenty-five-ton car, up to 25 miles per hour, tractive effort equals 20 lbs. per ton.
Twenty-five-ton car, up to 50 miles per hour, tractive effort equals 25 lbs. per ton.
One hundred-ton train, up to 25 miles per hour, tractive effort equals 15 lbs. per ton.
Heavy freight train, up to 25 miles per hour, tractive effort equals 6 lbs. to 10 lbs. per ton.

The above figures would be considerably increased by presence of snow or dirt on the track.

Tractive Coefficient.

This coefficient is usually expressed as the ratio between the weight on the driving wheels and the total tractive effort, and is dependent upon the adhesion between wheels and rail. It has a variable value for the same equipment, being largely affected by the condition of the rails, whether wet, dry, or sanded.

In train work, it may be stated as a general rule, that the weight on the driving wheels should be at least six times the tractive effort required. For example, the weight of a locomotive necessary to haul a 100-ton train up a 2 per cent. grade would be found as follows:—

100 × 15 lbs. friction = 1,500 lbs. for friction of train.
100 × 40 lbs. for grade = 4,000 lbs. for grade.

Total tractive effort required, 5,500 lbs. for train only.
Assuming a 20-ton locomotive, we have:—

20 × 15 lbs. for friction = 300 lbs.
20 × 40 lbs. for grade = 800 lbs.

Total tractive effort for locomotive only ...	1,100 lbs.
Total tractive effort for train...	5,500 „
Total	6,600 lbs.

This is 16·5 per cent. of 20 tons, the weight of the locomotive, it being assumed that all axles on the locomotive are equipped with motors, and the entire weight is, therefore, available for traction.

Starting this train on the 2 per cent. grade, assuming the slow accelerating rate of one-third of a mile an hour

per second, would require an additional tractive effort of $\frac{92 \cdot 3}{3} = 30.8$ lbs. per ton, a total of 11,543 lbs. This would necessitate using a 35-ton locomotive, and the total tractive effort in this case is 16·8 per cent. of the weight of the locomotive, or 35 tons.

The following table is based on the results of a series of tests and shows, in a general way, the variation in the tractive coefficient under different conditions:—

TRACTIVE COEFFICIENT.

	Per cent.	Sanded, per cent.
Dry rail	28	28
Thoroughly wet rail	20	25
Greasy moist rail	15	25

With ice or snow on the rails, the coefficient may be even lower, while the rolling friction at the same time may be largely increased on account of the snow. With this fact in mind, the value of four-motor equipments, even for single cars, is evident, especially on suburban service, where the cars run through an open country exposed to snow and ice.

AVERAGE ENERGY.

To approximate the capacity of the power station for any given service, the average energy required may be assumed as 100 watt-hours per ton-mile × schedule speed. As an example, assume a schedule speed of 12 miles per hour, and a car weighing 15 tons. The average kilowatt rate of energy consumption per car would be

100 watt-hours × 15 tons × 12 m.p.h. = 18,000 watts = 18 KW.

The figure of 100 watt-hours per ton-mile × schedule speed is generally correct for the ordinary conditions of city and suburban service. If the stops are a mile or more apart, the energy consumption may be as low as 60 watt-hours or 70 watt-hours, while frequent stops and very high schedule speeds may increase this figure to 120 watt-hours or even more.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

20,666. "Improvements in regulating and starting switches for electric motors." R. DOBSON. Dated October 16th.

20,668. "Improvements in obtaining heat and vapourising fluids by electricity." R. C. SAYER. Dated October 16th. (Complete.)

20,678. "A short-circuit switch for electrical machines." R. J. HOUGHTON. Dated October 16th.

20,689. "A new or improved method of automatically extinguishing electric and gas lights at any required time, and apparatus for effecting same." F. W. SMITH. Dated October 16th.

20,705. "Improvements in and connected with electrically energised pendulum clocks." G. D. GRANGER. Dated October 16th.

20,720. "Improvements connected with electric lamps having illuminated bodies composed of second-class conductors." V. I. FEENY. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated October 16th. (Complete.)

20,732. "Improvements in accumulators for mixed fluids under pressure." W. J. CRUYT. Dated October 16th.

20,743. "Improvements in electricity meters." J. TOURTEL. (P. Rissler and H. Bauer, Germany.) Dated October 17th. (Complete.)

20,751. "An improved device for steering electrically-driven motor cars." E. ANDREAS. Dated October 17th.

20,758. "Improvements in lanterns or globes chiefly for incandescent gas lights, arc lights and the like." S. BIHELLER. Dated October 17th. (Complete.)

20,790. "An improvement in safety fuses for electric circuits." A. C. F. WEBB. Dated October 17th.

20,793. "Improved means and apparatus for regulating the speed of gas and like engines driving dynamo-electric machines." J. RICHARDSON and F. S. HIGHTON. Dated October 17th.

20,803. "Improvements in electric meters." THE BRITISH THOMSON-HOUSTON CO., LTD. (E. Thomson, U.S.) Dated October 17th. (Complete.)

20,804. "Improvements in systems of electric conversion comprising static and rotary transformers." THE BRITISH THOMSON-HOUSTON CO., LTD., and H. M. HOBART. Dated October 17th.

20,818. "Improvements in primary electric batteries." A. A. BEADLE. Dated October 18th.

20,862. "Improvements in or relating to the method and apparatus used in electrostatically measuring electric currents in a working circuit and calibrating the measuring instruments so employed." G. L. ADDENBROOKE. Dated October 18th. (Complete.)

20,877. "Improvements in the manufacture of reflecting opalescent surfaces for electric lamps or glass reflectors." THE IMPROVED ELECTRIC GLOW LAMP CO., LTD., and A. BARNES. Dated October 18th.

20,900. "Electrically illuminated billiard marking board." H. M. SALMONY. Dated October 19th.

20,903. "Improvements in apparatus for working railway points and signals by electric power." F. W. WEBB and A. M. THOMPSON. Dated October 19th.

20,906. "Improvements in trolley standards used on cars or wagons electrically propelled from an overhead wire." E. M. MUNRO, W. WOOD, H. BECKNELL, and H. J. ROGERS. Dated October 19th.

20,912. "Improvements in electric tramways on a road contact system." W. H. MERRIMAN. Dated October 19th.

20,925. "A process for directly obtaining the caustic lyes and ammonia and earth alkaline hydroxides by electrolysis." C. LUCKOW, jun. Dated October 19th. (Complete.)

20,983. "Improvements in trolleys used on overhead wires for electric traction." W. WOOD. Dated October 20th. (Complete.)

20,986. "Improvements in machines for, and the method of, making electrodes for storage batteries." W. W. HANSCOM and A. HOUGH. Dated October 20th. (Complete.)

21,054. "A new hot wire arc lamp." G. E. CUTLAND and A. G. BRYANT. Dated October 21st.

21,076. "Improvements in electric cells or batteries." B. WILLCOX. (The Columbus Electricitatsgesellschaft, Gesellschaft mit beschrankter Haftung, Germany.) Dated October 21st.

21,079. "Improvements in time indicators for use in connection with a telephonic service." R. C. J. SUTHERLAND. Dated October 21st.

21,082. "Improvements in circuit breakers." G. WRIGHT. Dated October 21st. (Date claimed under Patents, &c., Act, 1883, Sec. 103, March 23rd, 1899, being date of application in the United States.)

21,083. "Improvements in controllers for electric motors." H. P. DAVIS and G. WRIGHT. Dated October 21st. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 24th, 1899, being date of application in the United States.)

21,084. "Improvements in magnetically operated locks suitable for safety lamps or other purposes." H. MANDT. Dated October 21st. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1899.

1,553. "Improvements in secondary storage batteries." W. M. McDougall. Dated January 23rd, 1899. A frame is moulded of rubber and powdered charcoal and has transverse apertures for the active material and is provided with vertical passages for enabling the inner or metallic portion to be inserted edgewise into the outer portion. 2 claims.

1,557. "Improved clockwork operated mechanism for switching electrical current." A. S. Soull. Dated January 20th, 1899. Relates to mechanism for making and breaking circuits at predetermined times. In one arrangement a lever carrying a forked contact is tilted to complete a circuit through mercury cups by means of a cam or snail fitted on the arbor of a wheel driven by clockwork. The cam acts on a pin carried by the lever, and after the lapse of a certain time allows the lever to tilt again suddenly and break the circuit. In order to give a quick make to the circuit, the lever is made flexible, the limit of movement being controlled by a screw, but when the end of the spring reaches the notch the lever drops suddenly. The clockwork may be stopped on any predetermined day by means of a second cam or pawl carried on the arbor of a wheel rotating, say, once in six days. The pawl engages with the end of a spring-controlled lever, and acts against a stop pin. The wheel arbors are fitted with pointers working on the clock dial. The apparatus is applicable for illuminated advertisements, &c. 3 claims.

1,810. "Improvements in electrical weaving frames or looms." H. Boulange and E. Fregnac. Dated January 26th, 1899. An electrical motor is fixed to a base plate so that its horizontal axis is level with the centre of the cam shaft. The power is transmitted through a set of cogs, a shaft and a bevel gearing to the cam shaft which drives the crank shaft through more bevel gearing. 2 claims.

2,386. "Improvements in apparatus for use in connection with wireless telegraphy." M. J. Nehemias and H. F. A. Schroeder. Dated February 2nd, 1899. Consists of a warning and communicating device, for vessels at sea, based on wireless telegraphy, by means of coherer and relay apparatus which shows visible signals to the officers of both ships, and which the officers can use by the Morse code for communication. 3 claims.

3,440. "Improvements in and connected with means for electrically lighting railway carriages." E. Dick. Dated February 16th, 1899. Consists in the following improvements in Specification 8,179, 1898:—(1) The construction of the automatic commutator which consists of an electro-magnet between the poles of which a perforated parallel wound armature rotates. (2) The construction of the automatic switch. (3) The construction of the automatic regulator. Consists of a solenoid having two coils and a soft iron core, the height at which it is retained is controlled by the action of the coils. (4) To dispense with the resistance *r*. (5) To render the regulation independent of the number of carriages in the train. (6) To enable charging whilst the light is on. 10 claims.

4,068. "A new and useful method of manufacturing electric conductors and resistances." S. S. Bromhead. (W. C. Heraeus.) Dated February 23rd, 1899. Consists in making filaments of a mixture of argil and asbestos in equal proportions, or they may be made of the common silicate fused with ammonium platino-chloride and gum acacia and afterwards chemically treating them. 6 claims.

4,945. "Improvements in apparatus for registering the supply of electricity." L. Kahn. Dated March 6th, 1899. Relates to a meter which registers at a reduced tariff during the day. Consists of the combination with the meter of a supplementary clockwork, a rocking lever actuated by the clockwork at predetermined times, and a gear in said meter for registering ordinary and reduced rate, said gear being actuated by the rocking lever. 3 claims.

5,341. "Improvements in tumbler switches for electrical purposes." A. Watson. Dated March 11th, 1899. Consists in a sliding shutter which is adapted to be brought between the poles on the circuit being broken by the operation of the switch lever. 3 claims.

5,518. "Improvements in electric spark apparatus." T. B. Kinraide. Dated March 14th, 1899. Consists of a spark gap comprising a central post, a plurality of supporting posts, two plates, the lower plate pivotally mounted concentrically to the central post, a hanger depending adjacent to the central post, a spring between the central post and hanger and engaging the hanging at its lower end and held by the post at its upper end, three or more similar struts supporting the lower plate, and the upper plate being supported by supporting posts, a lever pivotally mounted adjacent the lower plate and loosely connected therewith at its inner end for rotating the lower plate and tipping the struts. 8 claims.

6,286. "An improvement in telephone systems." J. C. Slater. Dated March 23rd, 1899. Consists of a switchboard having a switch for each telephone in the system; an electro-magnet for each switch; mechanism for each switch whereby the electro-magnets operate the switches; a series of contact points for each switch equal to the number of the other switches, each switch being numbered, and having a corresponding numbered contact point upon each of the other switches. Telephones at outlying stations, one for each switch, and correspondingly numbered; a circuit breaker at each telephone; a battery at each telephone, and suitable connections. 14 claims.

6,287. "Improved apparatus for extracting or reducing metals for making metallic alloys by electrolysis." H. Bumb. Dated March 23rd, 1899. Consists in using molten metal as the cathode so that through the decomposition of a molten electrolyte, metals and metallic alloys are, under a simultaneous reduction of the same, eventually obtained. 3 claims.

6,604. "Improvements in electric igniting apparatus for explosion engines." P. M. Justice. (The Pope Manufacturing Company, Incorporated.) Dated March 27th, 1899. Comprises a permanent field magnet an armature wound for alternating current with its contacts, one of the parts being rotated with respect to the other to generate current, and the other of the parts being rotatably adjustable to vary the maximum point in the current. 11 claims.

6,816. "Improvements in electric cigar lighter." W. F. Kessler. Dated March 29th, 1899. The device has a horizontal swivelling shell body containing the operative mechanism, within which the ignition spark is thrown a pendant wick tube and oil reservoir fixed in the shell, a hand lever centered on said reservoir carrying an extinguishing cap upon its inner end and provided with a pivoted sparking device adapted to throw the spark within the shell. 8 claims.

6,886. "A new or improved system of wiring electrical installations." F. Bathurst. Dated March 30th, 1899. Consists of the use of a single bare wire carried through an armoured conduit or metallic tube, with a lining made of insulating material of an elastic nature. The wire forms the positive lead and the conduit, the negative lead is not insulated and is therefore kept at earth potential. 3 claims.

7,006. "Improved means for controlling the discharge of electric storage batteries." P. M. Justice. (The Pope Manufacturing Company, Incorporated.) Dated April 1st, 1899. Relates to exhaustion of batteries below the danger point. Consists either in a visual or audible signal to the operator, or an automatic cut-out comprising two solenoids acting in opposition upon the cut-out, one of said solenoids being coarse wound and tending to open said cut-out, and the other being fine wound and tending to keep the cut-out closed, but permitting the other solenoid to open the cut-out when the potential of the car falls below the normal, and a lock to prevent movement of the cut-out. 6 claims.

7,878. "Improvements in and relating to electric motors or dynamo-electric machines." R. Lundell. Dated April 15th, 1899. Date applied for under Section 103, Act 1883, being date of application in United States, January 18th, 1899.) Consists of a field coil holder for dynamo-electric machines consisting of a wedge-shaped polar extensions of high magnetic re'uctance between the coil and its core and secured in place by the groove and catch, a brush holder having a metal supporting shank surrounded by a substantially square insulating sleeve, also a clamp for a brush holder, consisting of an eye bolt and an insulating sleeve adapted to be held by the eye bolt between two stationary ribs. 5 claims.

7,879. "Improvements in and relating to methods and means for regulating electric motors." R. Lundell. Dated April 15th, 1899. (Date applied for under Section 103, Act 1883, March 3rd, 1899, being date of application in United States.) Consists in the employment of an electric motor furnished with two armature windings, two commutators, and a field magnet so constructed that it will be possible to run with weak field strength without sparking at the brushes, and with its electric circuits so arranged, that before a change of current from series to parallel the speed of the motor is so increased by reason of the weaker field that it will approximate to the speed obtained with strong field after the change to parallel is effected. 7 claims.

8,482. "Improvements in alternating current motors." M. Deri. Dated April 22nd, 1899. Relates to Specification 2,426, 1898. Consists in the deposition of magnetic fields excited by means of alternating currents, now with an optional number of poles and now with an also optional number of poles, but different from the first, in combination with resistance introduced into the armature winding in such a manner that they convey current on starting the motor in the magnetic field with n poles, while they carry no current when the motor runs in the magnetic field having a number of poles differing from n. 2 claims.

8,999. "Automatic electrical ring off appliance for telephone stations." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated May 11th, 1899. During the use of the telephone a polarisation cell is introduced into the circuit, while at the switchboard of the telephone exchange there is connected between the point and neck of the peg, a ring-off device, so that during speaking the cells prevent movement of the device, but if the telephone receiver is hung the corresponding cell is cut out operating the ring-off device, so that the attendant is informed of the end of the speech. 2 claims.

10,135. "Improvements in controlling devices for electric motors." The British Thomson-Houston Company, Limited. (W. B. Potter, United States). Dated May 13th, 1899. Consists of a lost motion connection between the handle and the switch controlling the motors, together with means for causing the switch to follow the handle at a uniform rate. The device shown is a spring with suitable speed-governing apparatus by which the progress of the switch is regulated. 13 claims.

10,136. "Improvements in systems of controlling electrically propelled railway trains." The British Thomson-Houston Company, Limited. (H. W. Buck, United States.) Dated May 13th, 1899. Instead of using a continuous current motor for rotating the different controllers a motor controller, consisting of a Gramme ring with leads passing to it at a number of points. Within the ring is a bar magnet which operates as a revolving field. The master controller transmits two-phase currents to the Gramme ring, polarising the latter, so that a rotary field is set up with the line of polarisation, of which the bar magnet keeps step. The master controller consists of two rheostats so connected across the mains that as one is cut in the other is cut out, and the circuits of the Gramme ring are connected at four points to the rheostat switch, so that by the rotation of the latter two-phase currents are set up. 7 claims.

10,205. "Improvements in liquid feed devices for electrolytic and kindred apparatus." R. Girouard. Dated May 15th, 1899. Relates to devices for feeding liquid to electrolytic apparatus. Refers to apparatus in fig. 10 of Specification 8,001, 1894. Consists of a supply reservoir, a delivery vessel, a capillary conduit connecting the supply reservoir with the delivery vessel, the same delivery vessel mounted on and carried by the capillary conduit and vertically adjustable therewith, and an outlet from the delivery vessel. 6 claims.

10,320. "Improvements in electrodes and electrode connections in liquid feed devices, and in the construction of enclosing vessels for electrolytic and kindred apparatus." H. Carmichael. Dated May 16th, 1899. Relates to Specification 8,061, 1894, and consists of an improvement in the anode there described. Consists of a corrodible conductor surrounded and contained by a non-corrodible insulating tube closed at one end, a non-corrodible conductor embedded in the material of the tube, having its uninsulated ends emerging therefrom, the corrodible conductor joined electrically to the intruding end of the non-corrodible conductor within the insulating tube, and leading therefrom to the open end of the said tube. 13 claims.

10,413. "An improvement in dynamo machines." C. de Kando. Dated May 17th, 1899. Consists in the use of polar extensions, the sectional area of which is gradually reduced toward the extremities for the reduction of cross-induction in dynamo machines. 1 claim.

10,586. "Electric apparatus by means of which a prize is automatically delivered when a target is hit." J. Domjen and C. Schrotter. Dated May 19th, 1899. The bull's eye is mounted on a sliding pin so that it is pushed backward by the blow of the projectile and completes an electric circuit, and the current passing through which liberates the arrested clockwork of an automatic apparatus of any suitable construction. 3 claims.

10,769. "Improvements in means for electrically igniting gas." F. W. Golby. (La Societe Anonyme "Lux Nova"). Dated May 23rd, 1899. Consists of a flexible gas pipe which also acts as an electrical conductor and is inserted in the circuit of the gas opening electro-magnet and is displaced by the armature of the electro-magnet, so that the contact formed between it and a fixed pipe is interrupted so as to produce a spark. 1 claim.

10,781. "Improvements in electric lighting apparatus." A. Plecher. Dated May 23rd, 1899. Relates to lighting apparatus for the purpose of X ray and general illumination. Consists in putting the electro-magnet or induction coil in the vacuum bulb, coiling the secondary wire along the primary from lamp to lamp, coiling the secondary around the primary between the lamps and arranging the electro-magnets diametrically opposite each other. 4 claims.

10,911. "Improvements in primary batteries." A. P. Fannenberg. Dated May 24th, 1899. Relates to carbon-zinc batteries. Consists in providing the carbon-electrode slotted where it is immersed in the electrolyte in order to increase the effective electrode area within a minimum space and to facilitate the adjustment of the electrodes in relation one to the other. 3 claims.

10,892. "Improvements in electrical warp stop motions for looms." W. H. Baker and F. E. Kip. Dated May 24th, 1899. Relates to apparatus for providing a loom for weaving pile fabrics and to provide for stopping the loom when the warp thread breaks without disengaging the pawls Comprises an easing device for the pile warp; terminals of the operating electric circuit carried by the easing device and gravity circuit-closing drops on the respective pile warp threads and said easing device, each of the drops being adapted to close the circuit between said circuit terminals when its supporting warp thread breaks. 8 claims.

11,105. "Relay apparatus for closing a subsidiary circuit of an electrical installation when a current in the main circuit has a certain strength of voltage." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated May 27th, 1899. A contact device is combined with any kind of electrical measuring apparatus in such a manner that by the depression of the pointer of the measuring apparatus when this is in the position corresponding to a certain strength of the current, a contact device will be actuated, thereby closing the circuit. 1 claim.

11,110. "Improvements in electric switches." A. M. Clark. (The General Incandescent Arc Light Company, Incorporated.) Dated May 27th, 1899. Relates to electric switches adapted to effect a rapid closure of the electric circuit. Consists of means for closing the circuit between the terminals comprising a plurality of bearing surfaces one being capable of being inclined with regard to the other, a plurality of moving pieces, each freely moving or sliding upon a bearing surface and a spring connection between the moving pieces whereby an electric circuit may be opened or closed by inclining one of the bearing surfaces in regard to the other. 5 claims.

11,024. "An improved electrical switch and fuse." H. C. Gover and C. W. Cox. Dated May 26th, 1899. Relates to a compact arrangement of an electrical fuse and switch in a single casing. The casing consists of a circular box of porcelain, having an outer wall and an inner concentric wall of the same material. The fuse is in the outer chamber, and the switch in the inner chamber. 1 claim.

11,097. "Improvements in sockets or holders for incandescent electric lamps." A. Vandam and T. H. Marsh. Dated May 27th, 1899. Relates to a socket or holder in which the spring plungers for making contact with the lamp terminals are not permanently connected with the electric light leads but make connection with plugs to which said leads are permanently secure when the various parts of the socket are in position. 3 claims.

11,106. "Improvements in synchronised electric blocks." Siemens Bros. & Co., Limited, and E. T. H. H. Lauckert. Dated May 29th, 1899. Consists in an arrangement of contacts and mechanism which prevents sparking on changes of contact, and which ensure accuracy in the movements imparted. 2 claims.

11,668. "Appliance for preventing fraudulent or erroneous changing of glow lamps in electric light installations." Siemens Bros. & Co., Limited. (Siemens and Halske Aktiengesellschaft, Germany.) Dated June 5th, 1899. Consists of a small plate composed of three different layers, and which is held in the screw-socket of the lamp fitting. The two outer layers are of insulating material, and the third is of metal. These layers have central holes of increasing size in the direction of the lamp base, the latter being provided with a metal stud of a size to pass through the smallest hole to make contact with the second terminal, while a larger lamp would be short-circuited. 1 claim.

11,422. "An improvement in electrolytic apparatus." J. G. A. Rhodin. Dated June 1st, 1899. Relates to apparatus for effecting decomposition of an alkali sulphate so as to produce caustic alkali and copper sulphate, which is decomposed into sulphuric acid and metallic copper. An electrolytic cell is divided by a porous partition into two compartments. The one is charged with sodium sulphate, in which there is an anode of copper connected to the positive terminal of a battery. The other compartment contains an aqueous solution of caustic soda, and has a cathode consisting of a layer of mercury. A current is passed through, with the resultant decomposition. 1 claim.

11,685. "Improvements in motor cars driven by electrical or other motive power." W. Miller. Dated June 5th, 1899. Consists of a motor car driven by electric power constructed with two side frames similar to the frames of ordinary bicycles, each furnished with a wheel fixed on a separate axle which does not extend through, and so fixed together by transverse connecting bars, diagonal ties, and by an arched yoke carrying the front wheel, that between and behind the wheels a space is provided uninterrupted for any constituent parts of the car and driving apparatus. 1 claim.

11,948. "Electric circuit closing device." F. Wilke. Dated June 8th, 1899. Consists of a circuit closing device, in which a spring pressure, acting on a substance which yields when it becomes hot, thereby closing the circuit by the spring coming in contact with a projection. 5 claims.

12,171. "Improvements in galvanic cells." W. R. Case. Dated June 10th, 1899. Consists in a galvanic cell of the form known as a single fluid cell provided with a positive element of carbon which is chemically attacked by the electrolyte forming carbon-dioxide, and the electrolyte is maintained in effective condition by a current of air being blown through it. 4 claims.

12,172. "Improvements in galvanic cells." W. E. Case. Dated June 10th, 1899. Consists in a galvanic cell of the form known as a two-fluid cell, having solutions of ferric and ferrous chloride, separated from each other by a porous medium, and having platinum in both solutions, and means for passing oxygen into the ferric solution. 4 claims.

12,309. "Improvements in storage batteries and method of preparing electrodes therefor." P. A. Newton. (The Nickerbocker Trust Company.) Dated June 13th, 1899. Consists in an intermediate bi-polar electrode for storage batteries having the sole electrical conducting connection between opposite sides of the electrode formed by finely divided active material, and a method of preparing the electrode, consisting in peroxidising the side of an integral body of lead oxide and reducing the other side of said body by passing an electrical current from face to face through the body, and a suitable electrolyte on the opposite faces of said body with the lead oxide constituting the sole electrical connection between the opposite side of the electrode. 19 claims.

12,490. "Improvements in and relating to electrical pendulum contacts for the operation of time measuring pendulums." A. G. Brooks. (Dr. L. Soil.) Dated June 15th, 1899. Relates to a device for the direct electrical operation of time measuring pendulums. It is based on the utilisation of the influence which power of inertia and frictional contact with the surrounding walls exert upon the motion of mercury in a vessel swinging with a given pendulum. 3 claims.

13,404. "Improvements in electric lamps." The British Thomson-Houston Company, Limited. (E. Thomson.) Dated June 28th, 1899. Consists in an improvement in that class of lamp in which the light-giving conductor is a pyro-electrolyte or is of such a nature that it is of low actual or apparent conductivity and ordinary temperatures particularly and the temperature of luminescence. Heat is caused by arcing. The lamp is self-starting. 9 claims.

13,418. "Improvements in or relating to telephones and the like." R. Hammerstein. Dated June 28th, 1899. Consists in the combination of a speaking tube or extension with a telephone or microphone for the purpose of securing a clearer transmission of sound. 8 claims.